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Endo et al.

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(54) **BOARD CONNECTOR**

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(51) **Int. Cl.**
H01R 12/75 (2011.01)
H01R 12/51 (2011.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H01R 12/51*** (2013.01); ***H01R 12/7011*** (2013.01); ***H01R 12/7023*** (2013.01); ***H01R 13/46*** (2013.01); *H01R 12/75* (2013.01)

(58) **Field of Classification Search**
CPC H01R 12/7005; H01R 12/721; H01R 13/506; H01R 13/6275; H01R 12/724;
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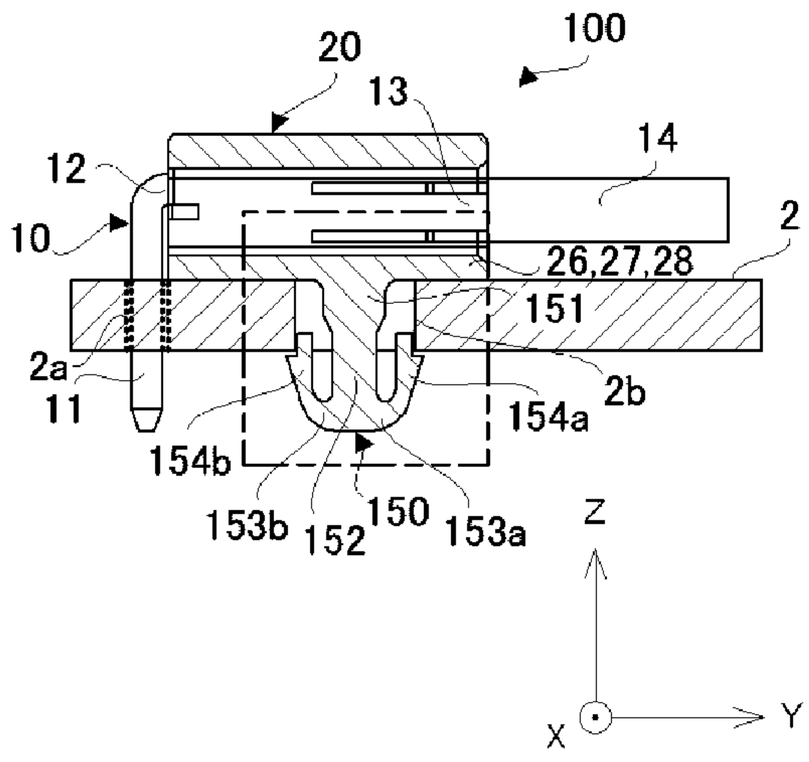
(74) *Attorney, Agent, or Firm* — Howard & Howard Attorneys PLLC

(57) **ABSTRACT**

A board connector includes: an L-shaped pin terminal including an insertion inserted into a through hole in a printed board and a conductor swaging part extending in a direction (+Y-axis direction) orthogonal to the insertion; and a housing disposed on one main surface (flat face on the +Z side) of the printed board, the housing containing at least an end of the conductor swaging part and having an opening into which a cable connected to the conductor swaging part is inserted. The board connector further includes a J-shaped boss formed integrally with the housing, the boss passing through a through hole in the printed board and protruding from another main surface (flat face on the −Z side) of the printed board, extending in a direction (D2) (the +Y-axis direction) opposite to a direction toward the insertion, and further extending toward the printed board.

6 Claims, 21 Drawing Sheets



(51) **Int. Cl.**
H01R 13/46 (2006.01)
H01R 12/70 (2011.01)

(58) **Field of Classification Search**
CPC .. H01R 12/88; H01R 12/7029; H01R 12/714; H01R 13/629; H01R 13/6595; H01R 12/707; H01R 12/712; H01R 12/73; H01R 12/79
See application file for complete search history.

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FIG.1

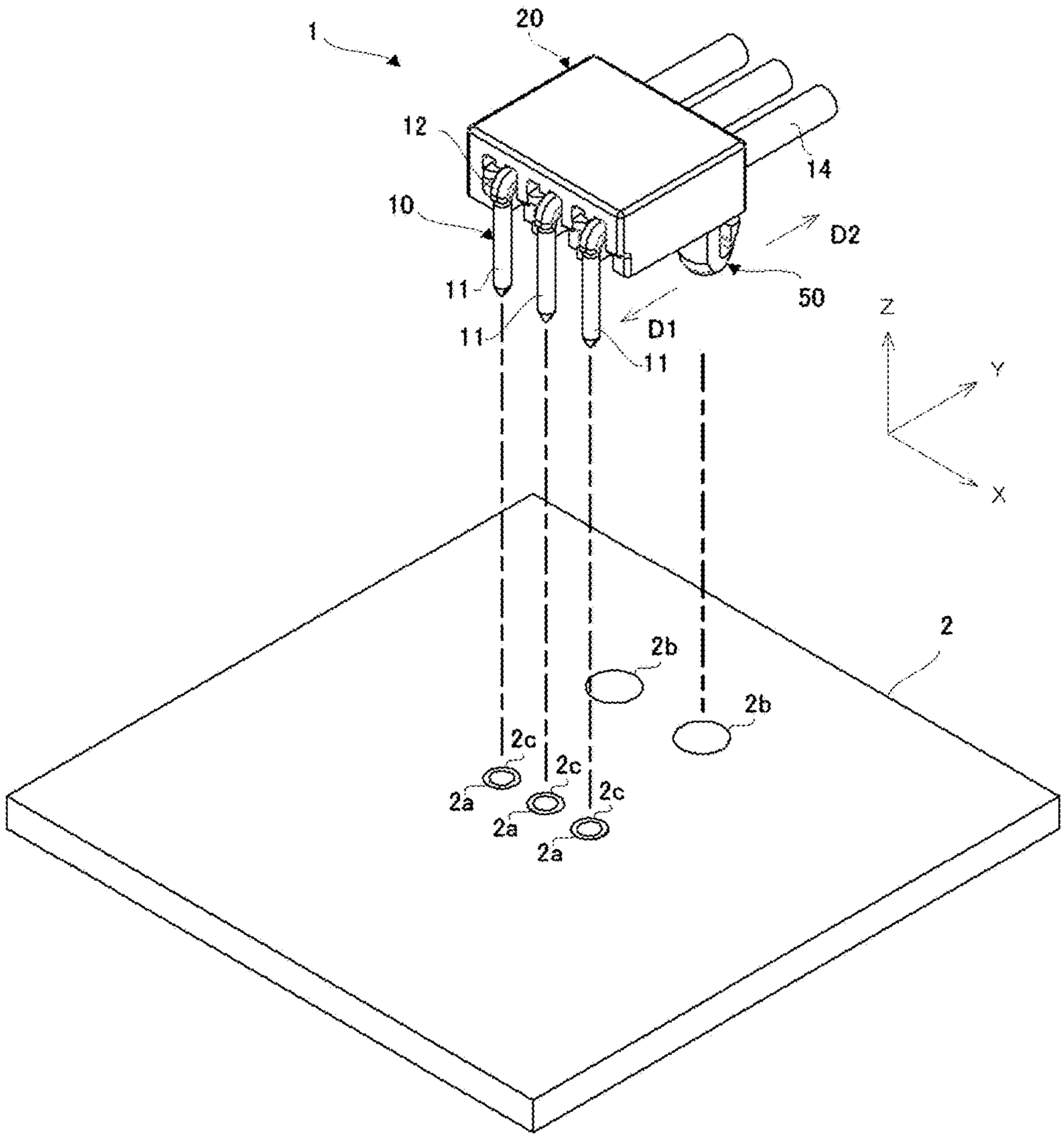

FIG.2

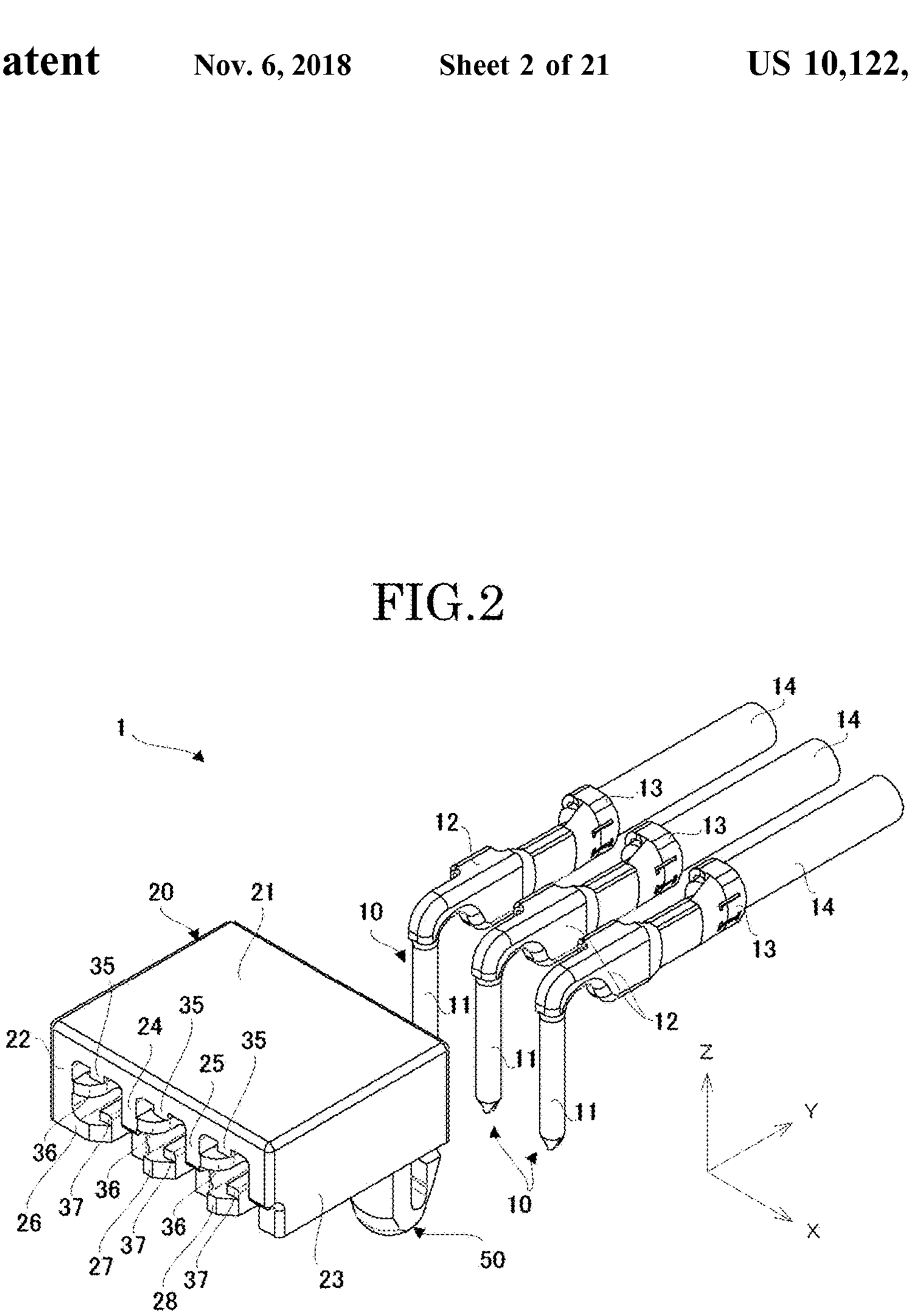
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FIG.3

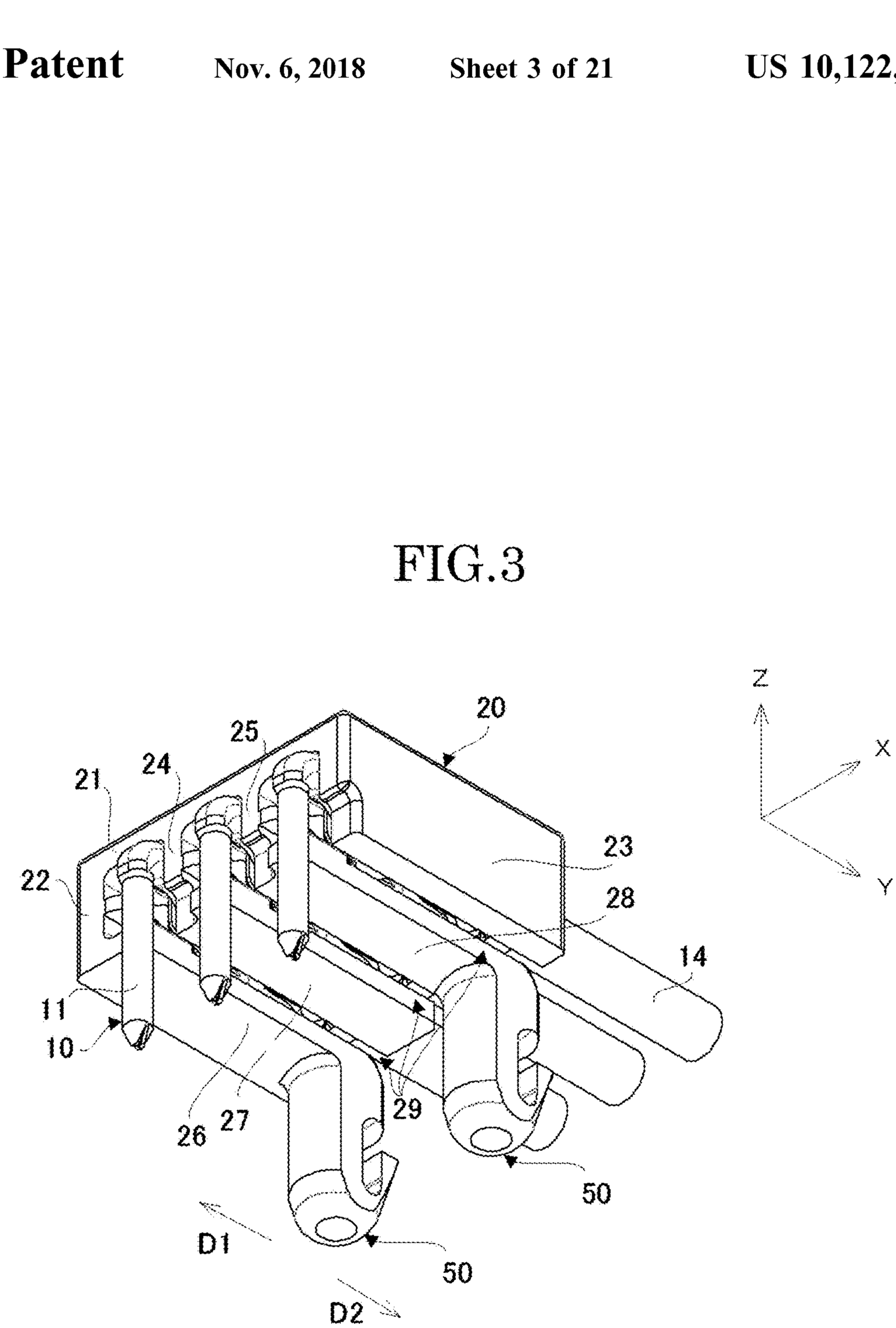

FIG.4

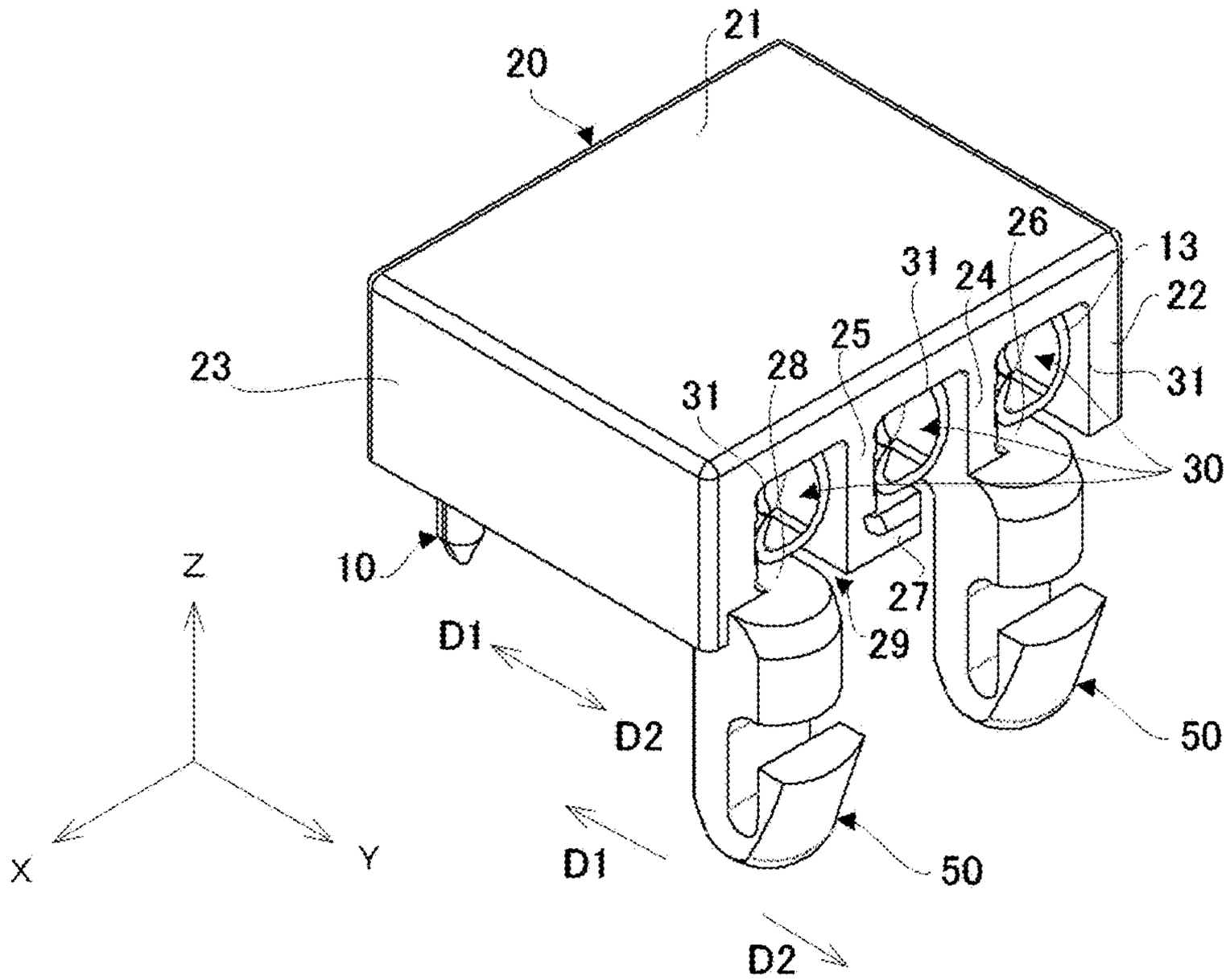

FIG.5

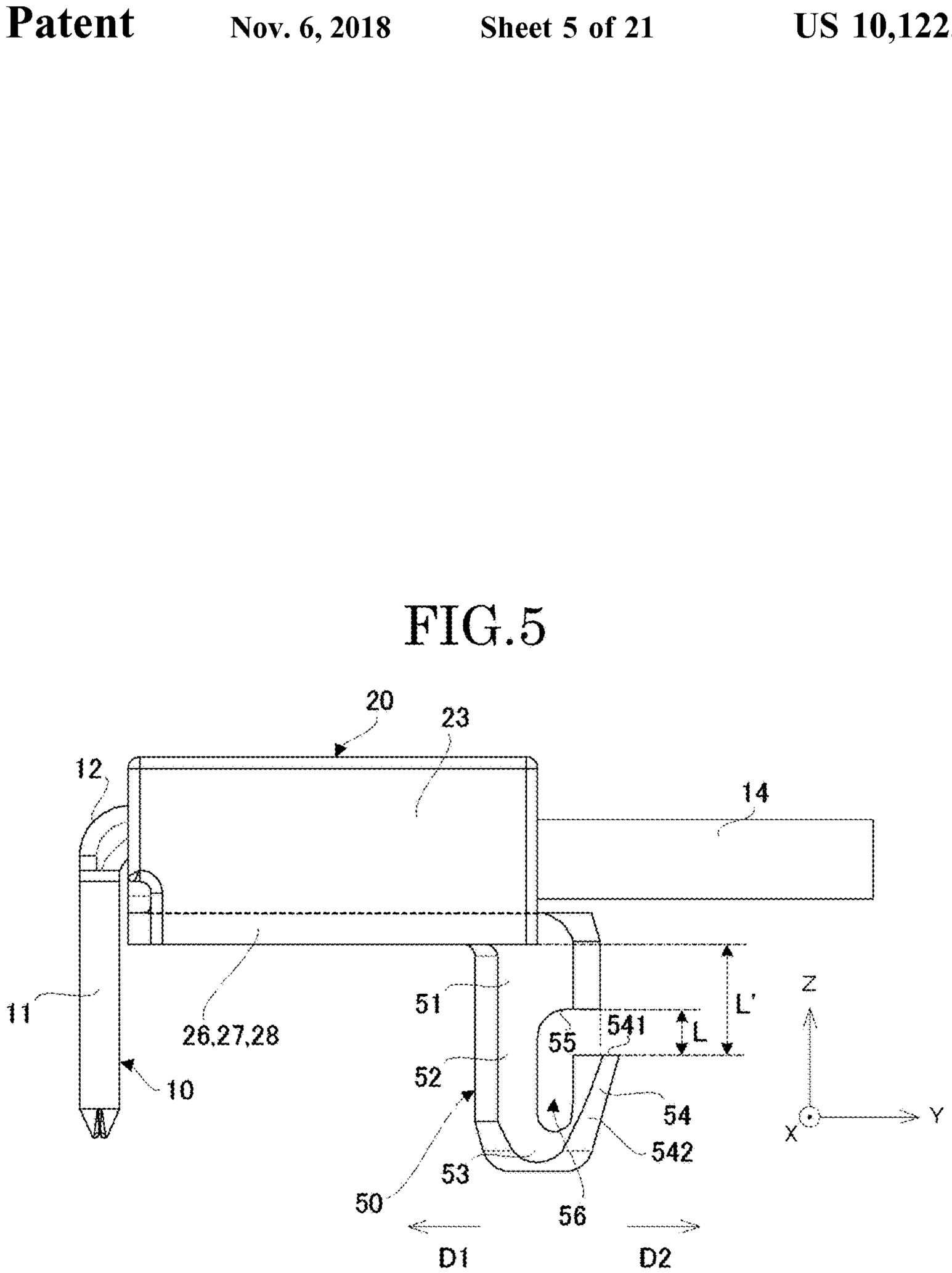

FIG.6A

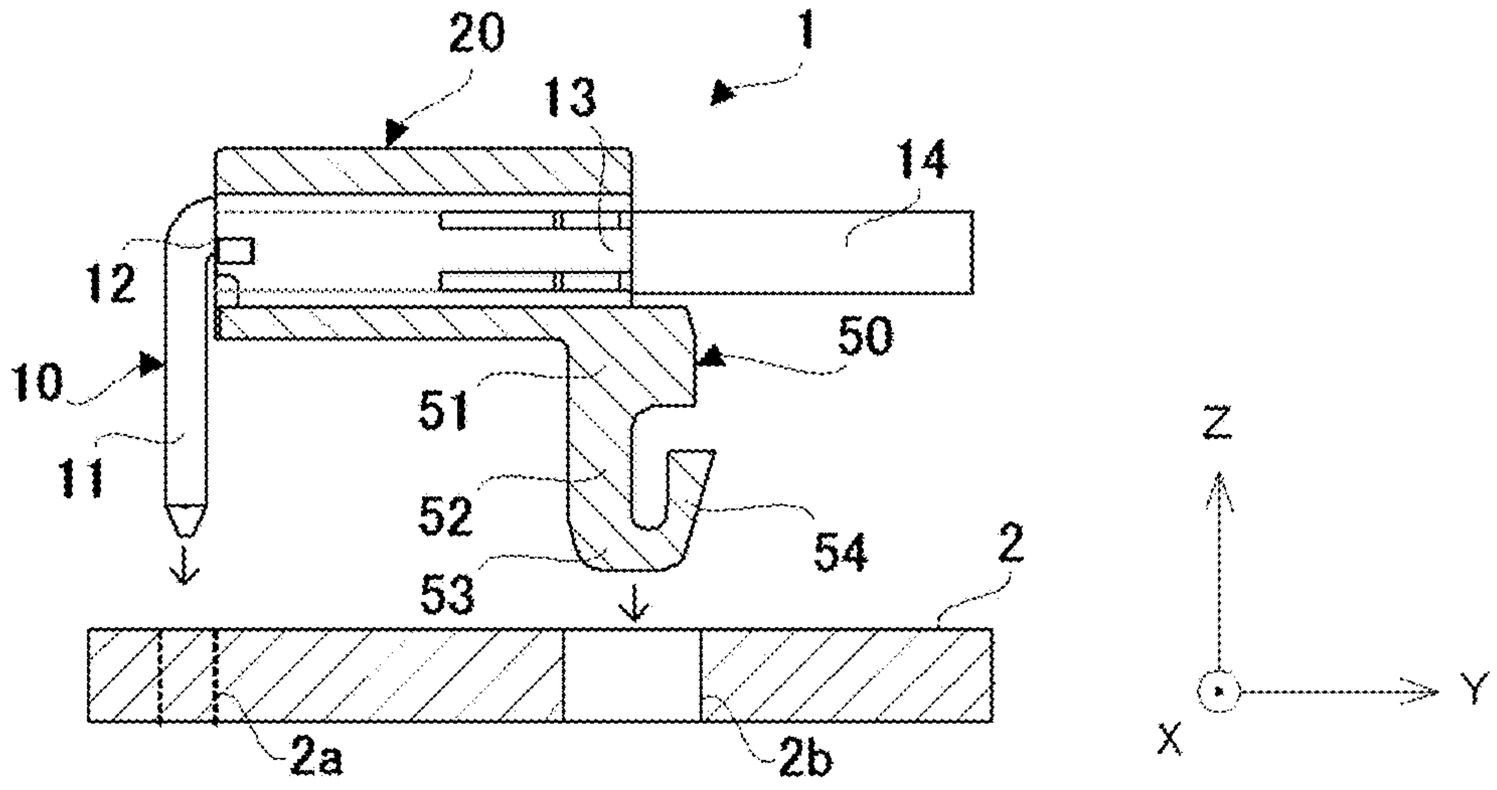

FIG.6B

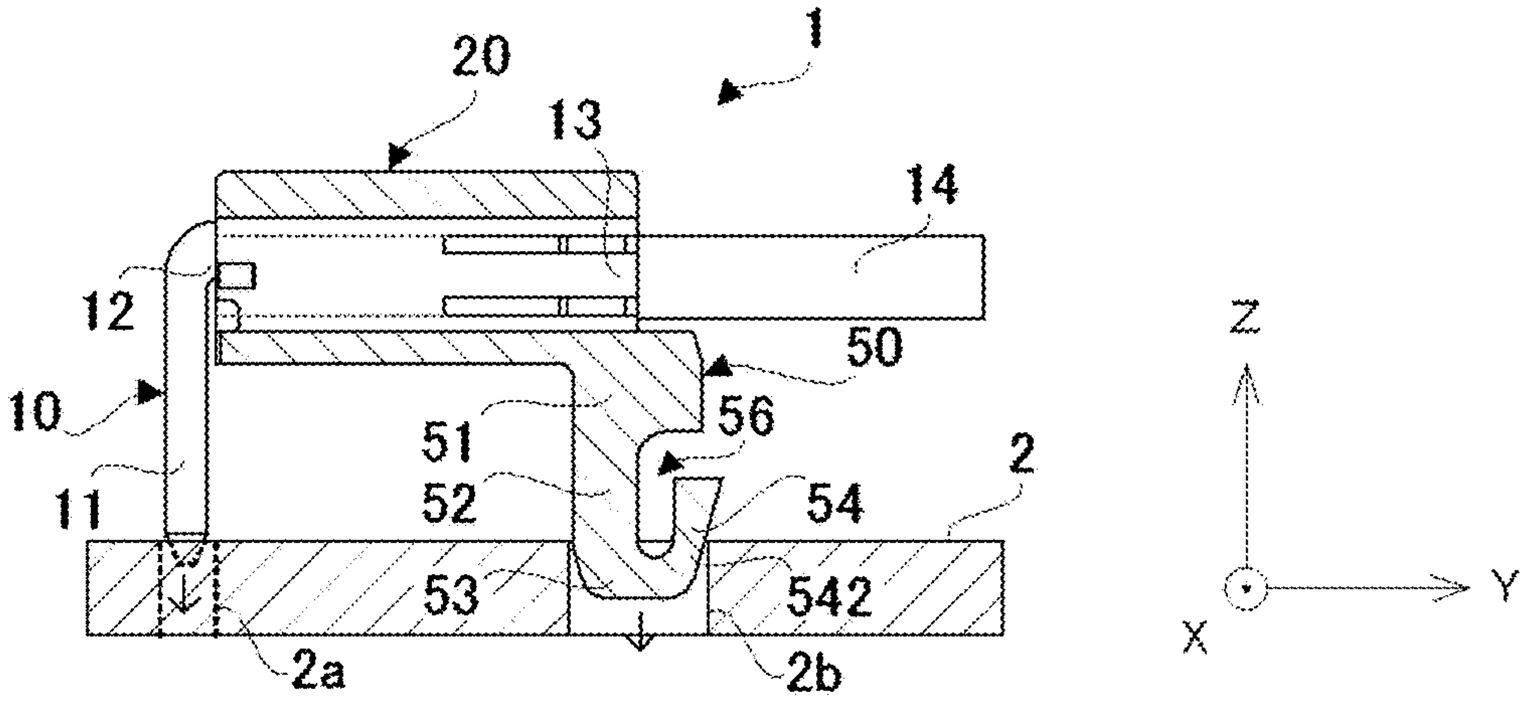

FIG.6C

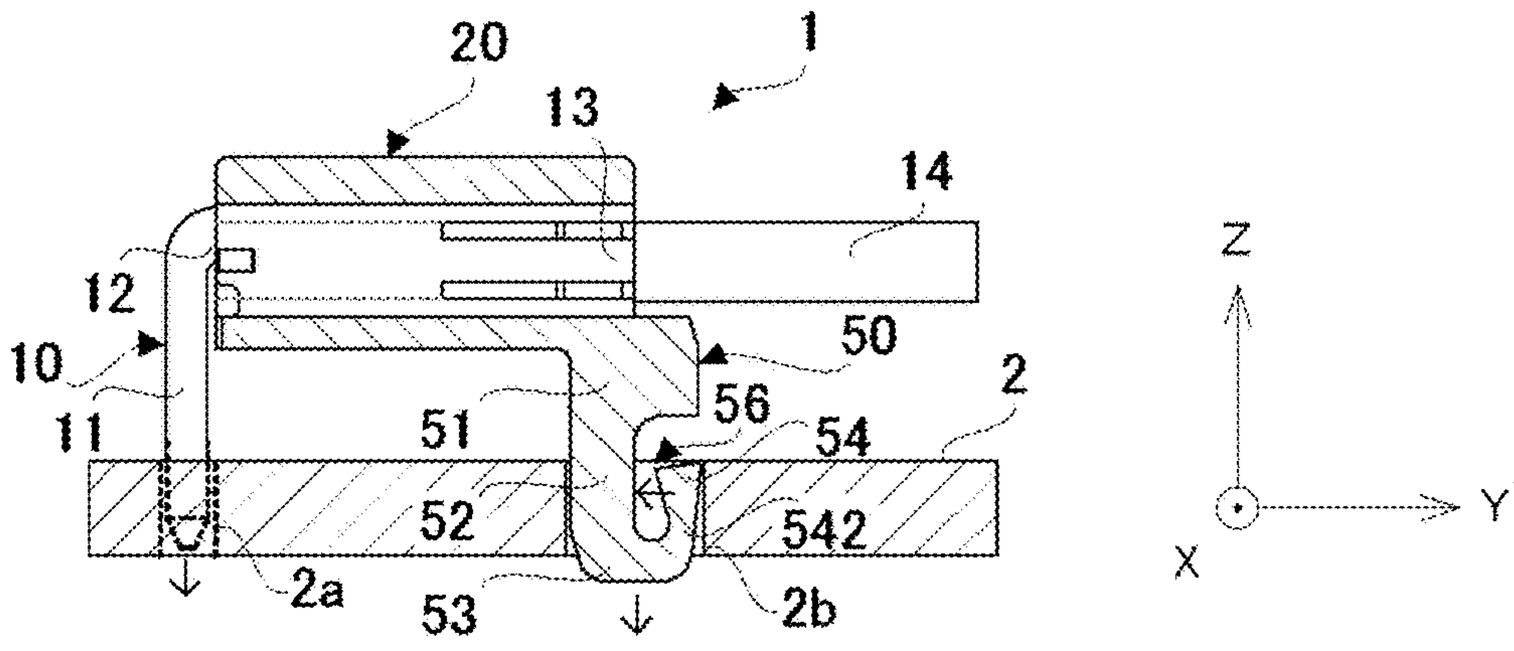

FIG.6D

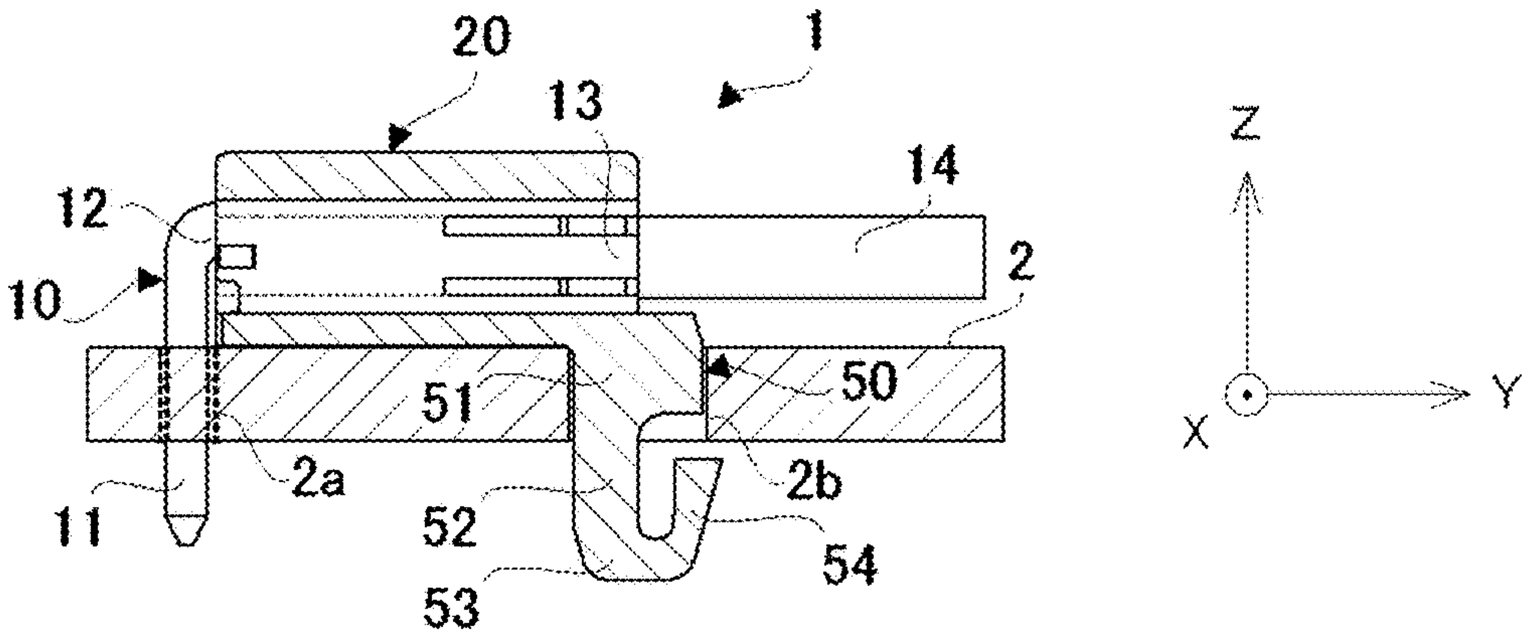

FIG.7A1

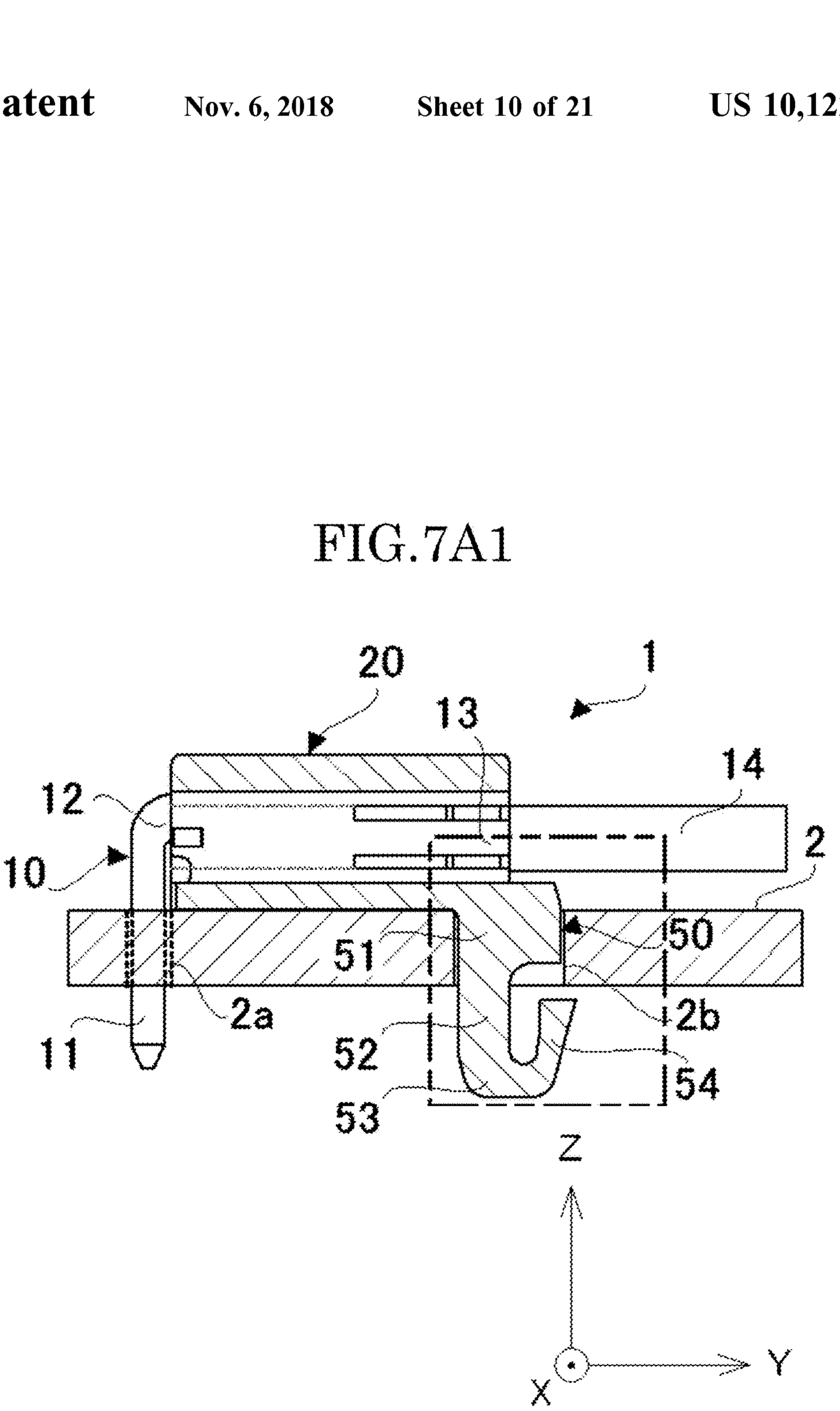

FIG.7A2

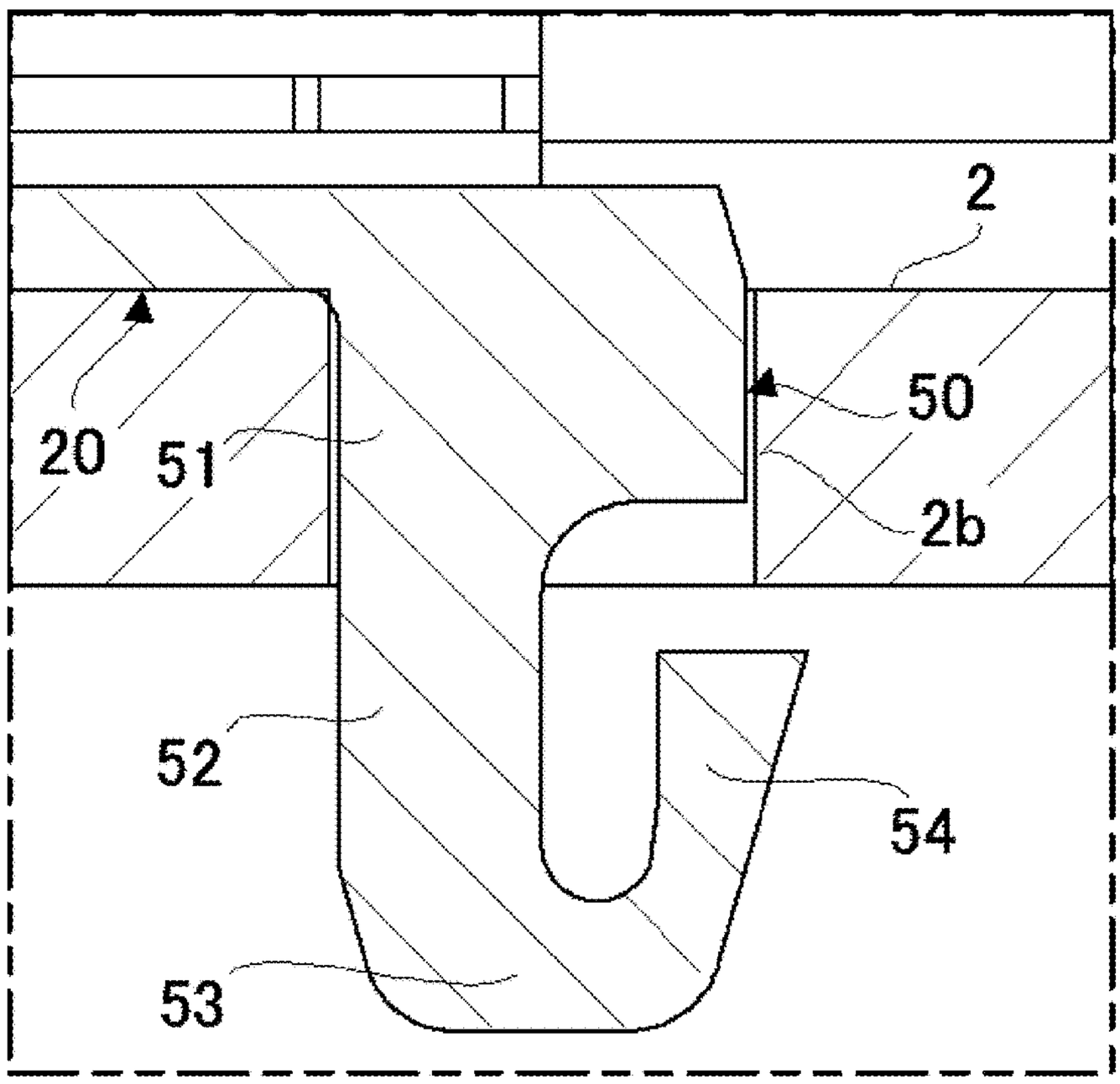

FIG.7B1

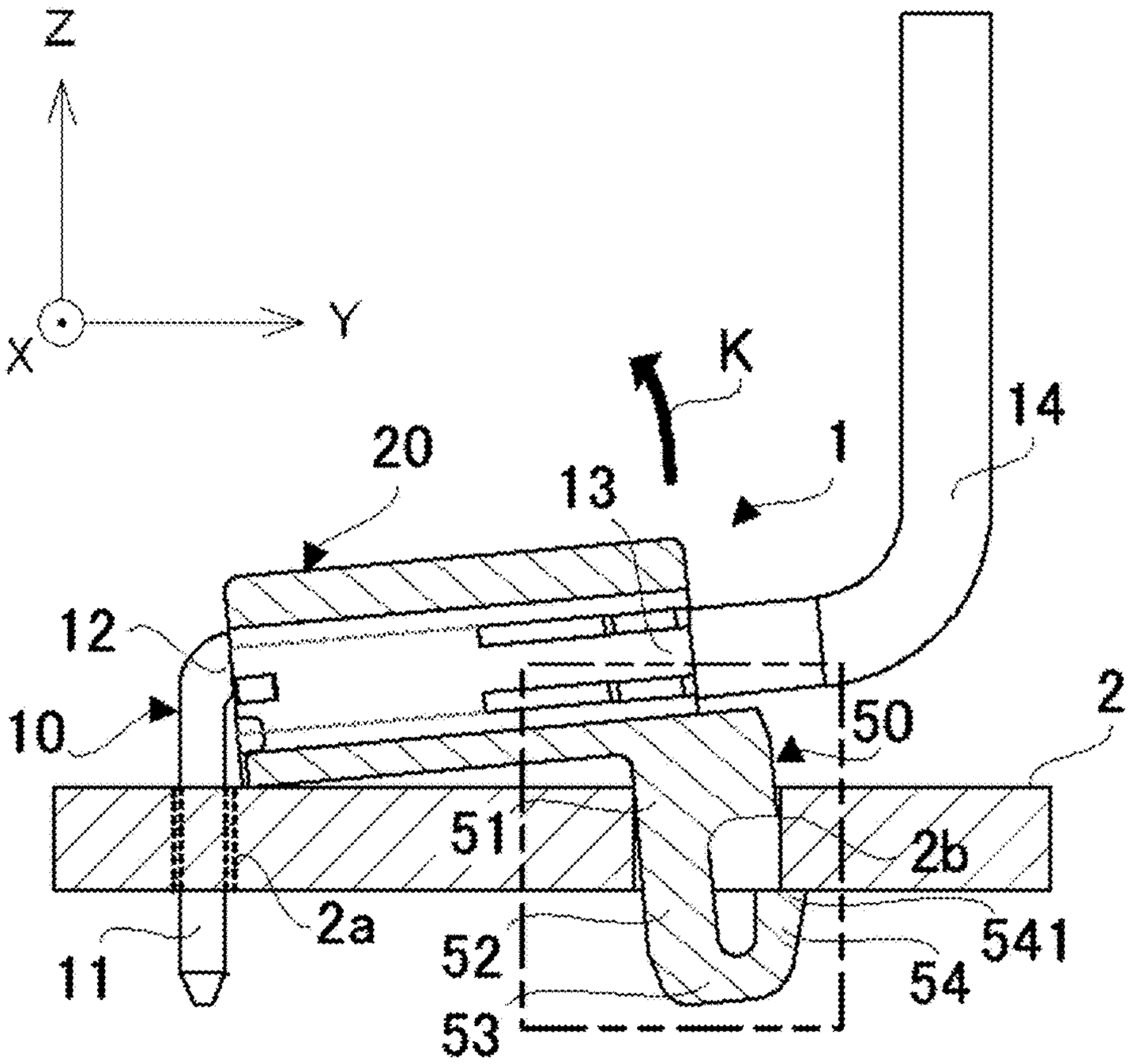

FIG.7B2

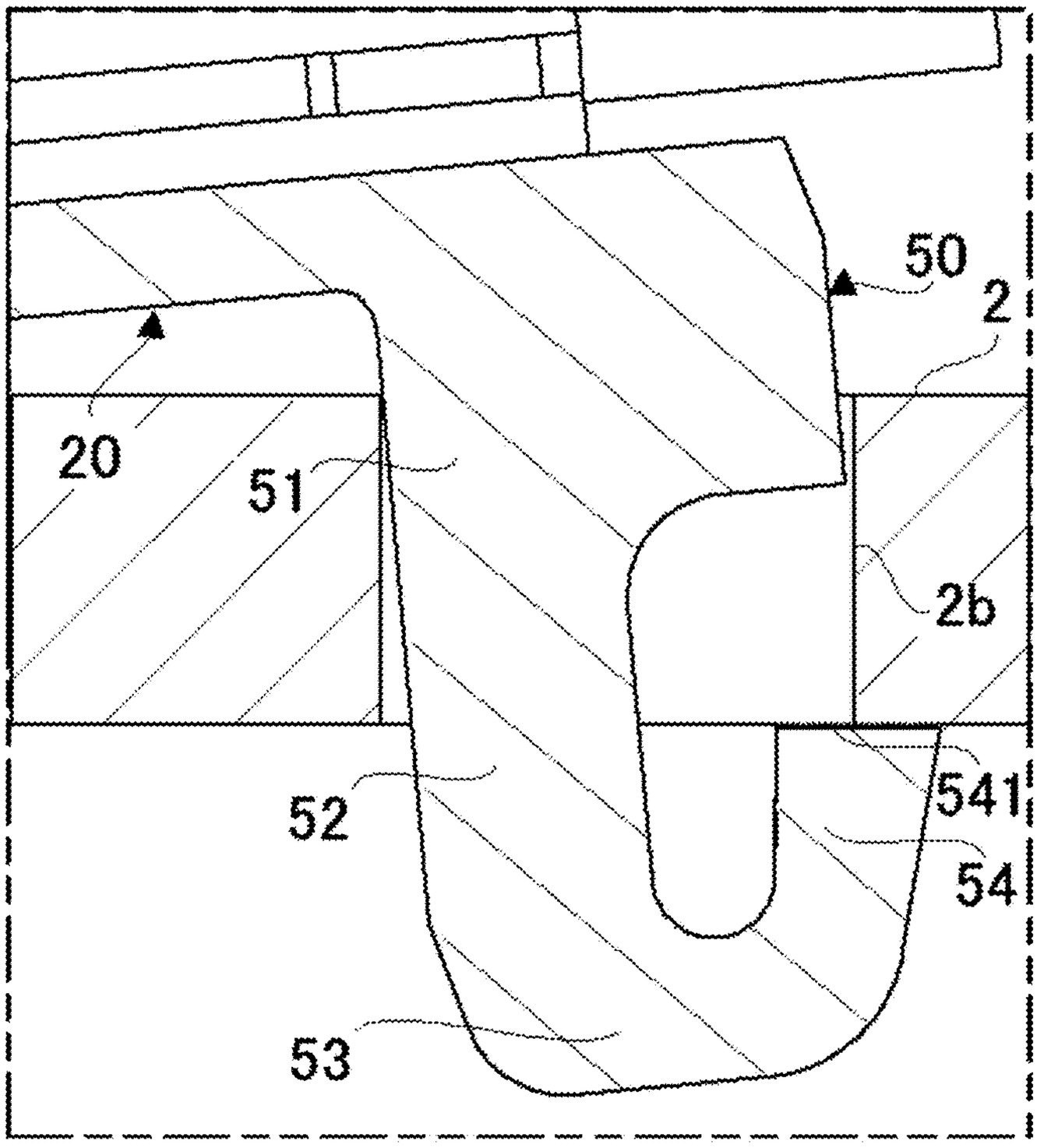

FIG.8A1

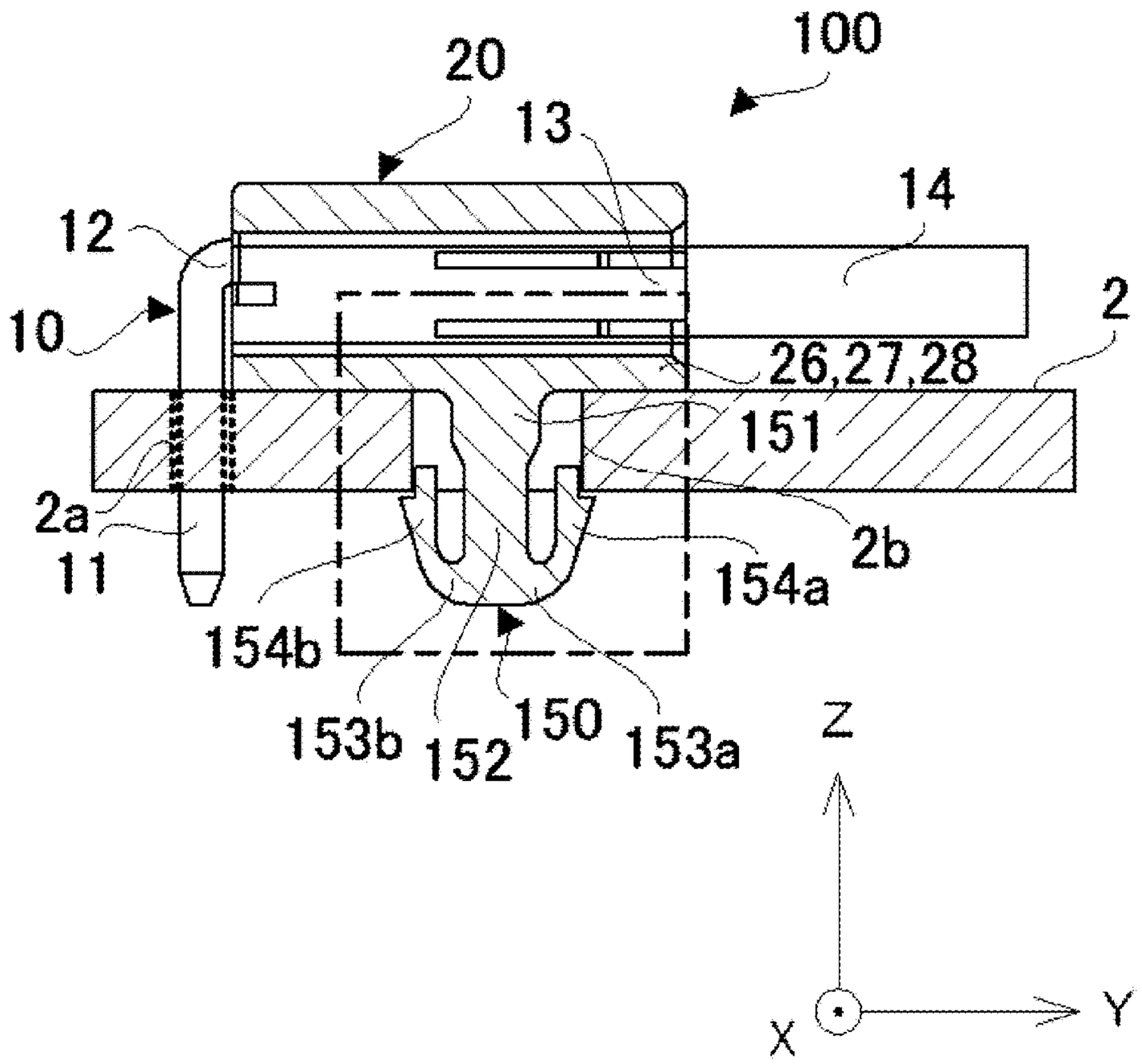
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FIG.8A2

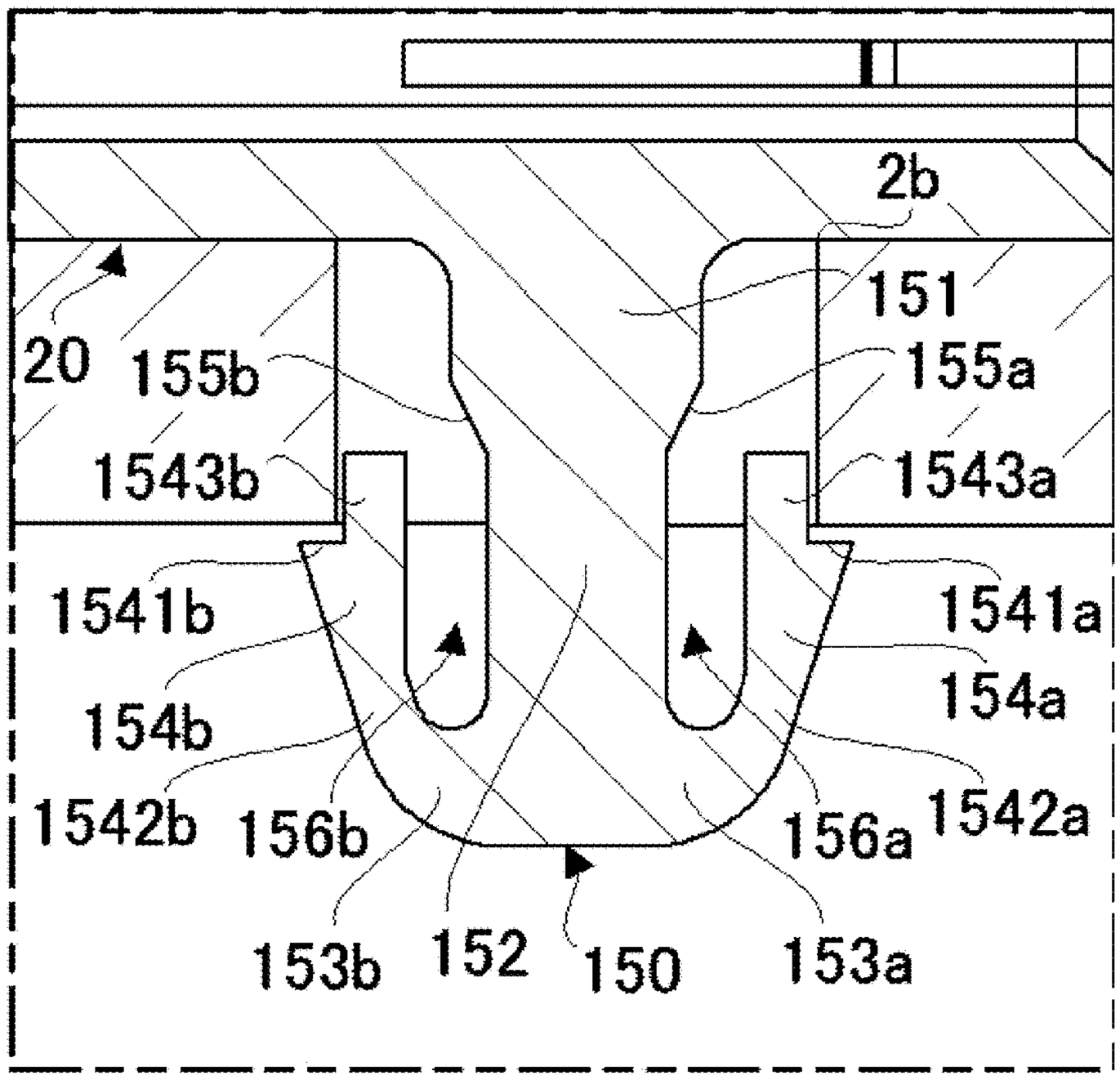
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FIG.8B1

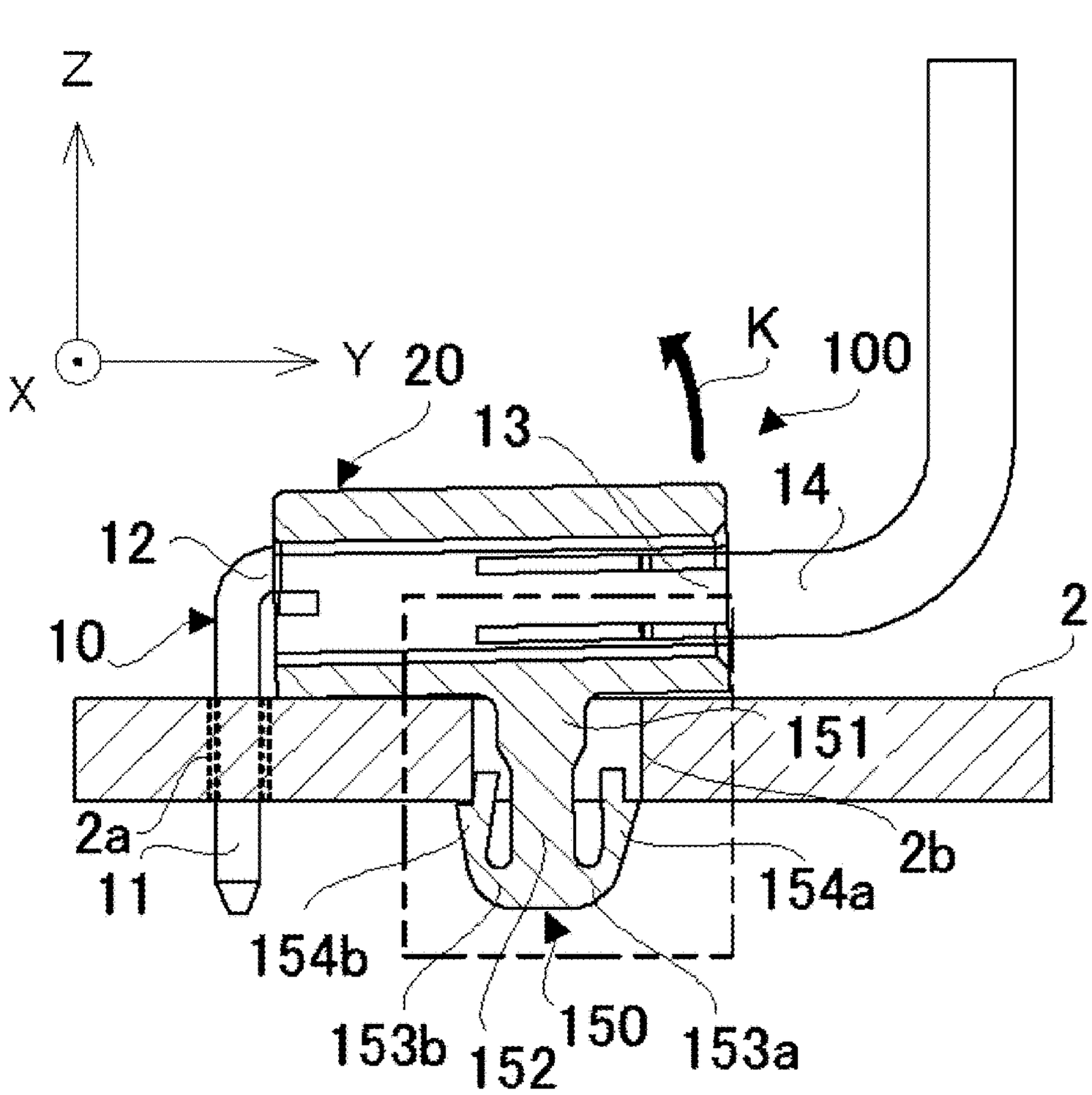

FIG.8B2

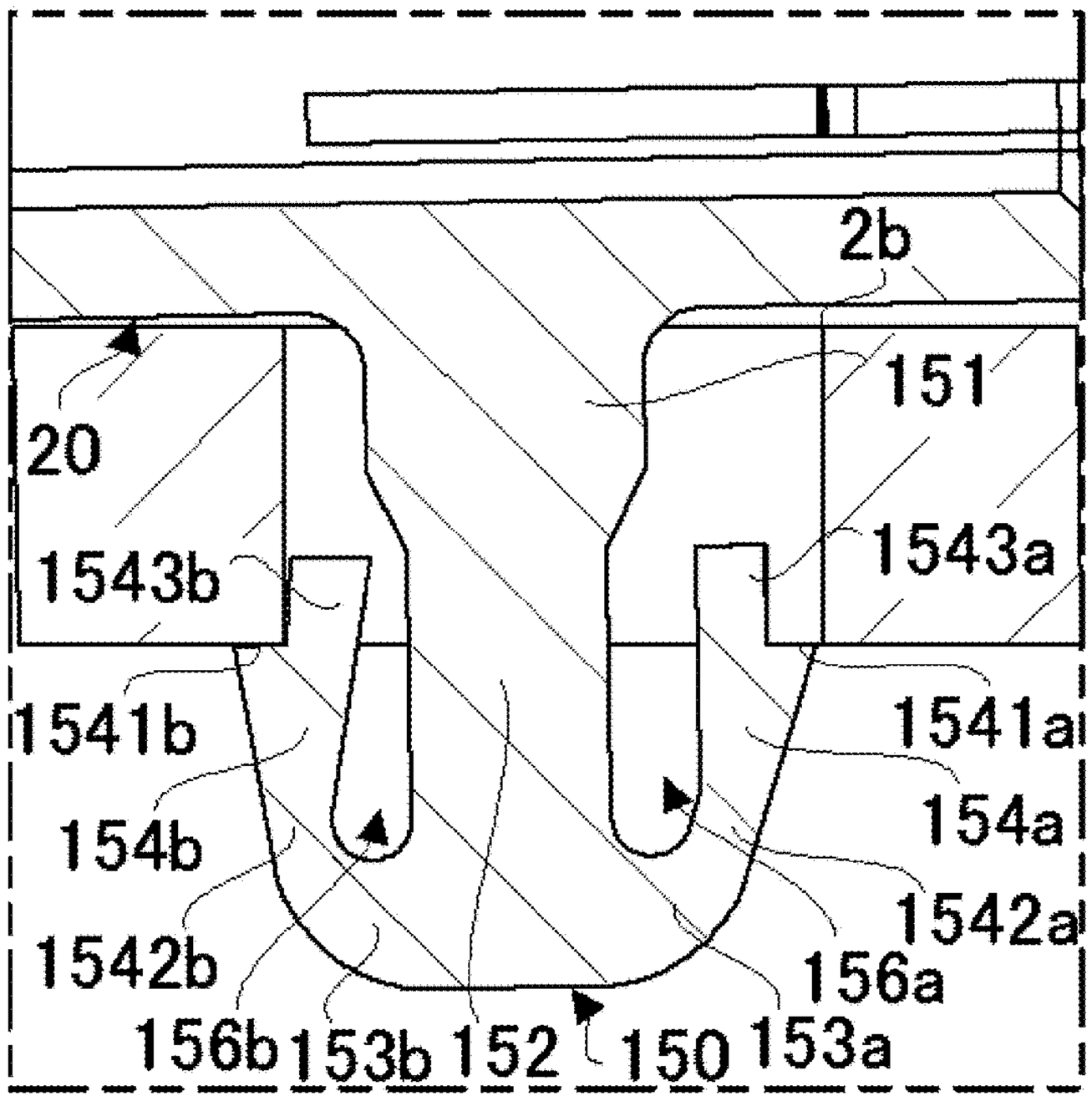
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FIG.9A1

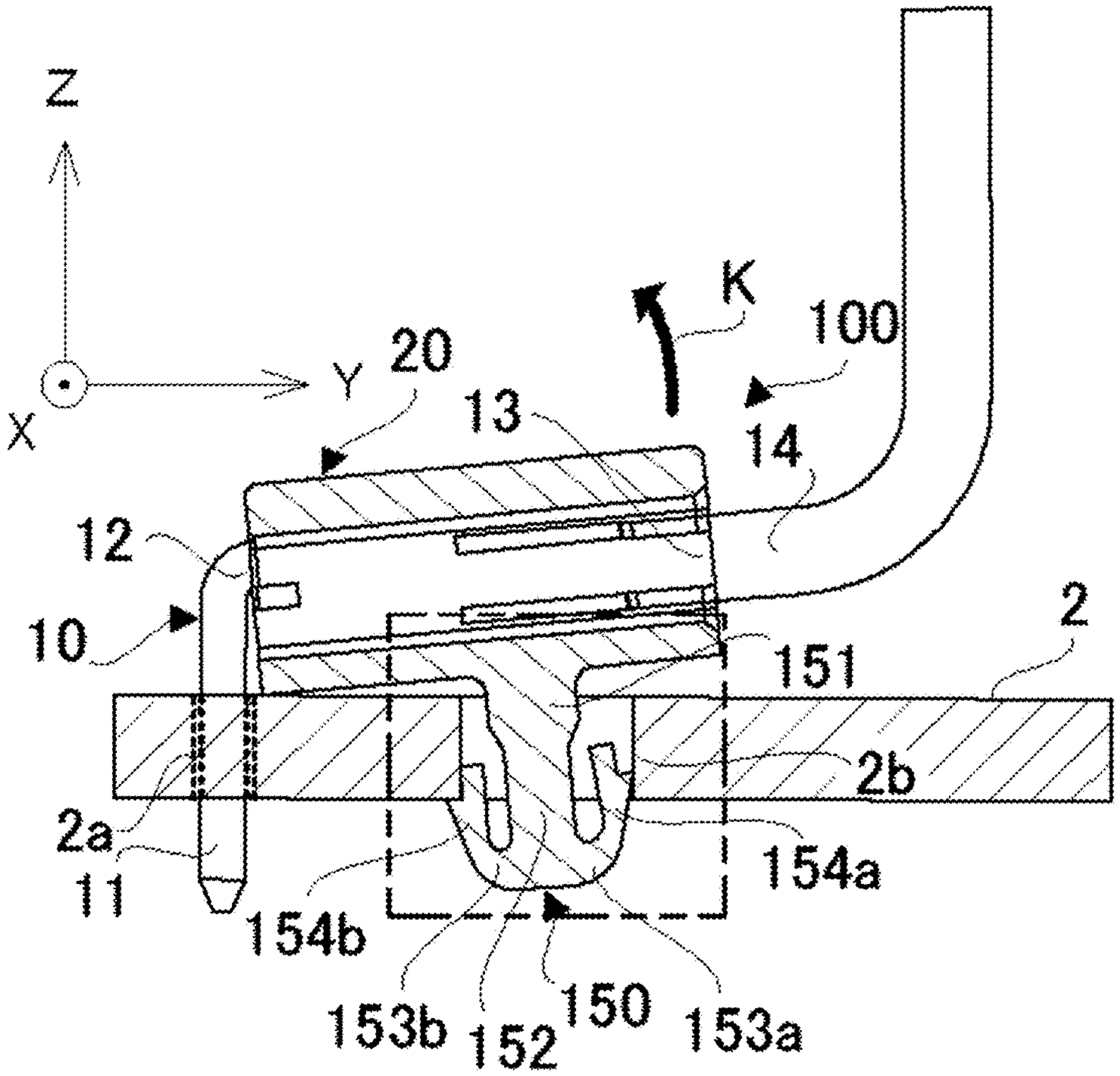

FIG.9A2

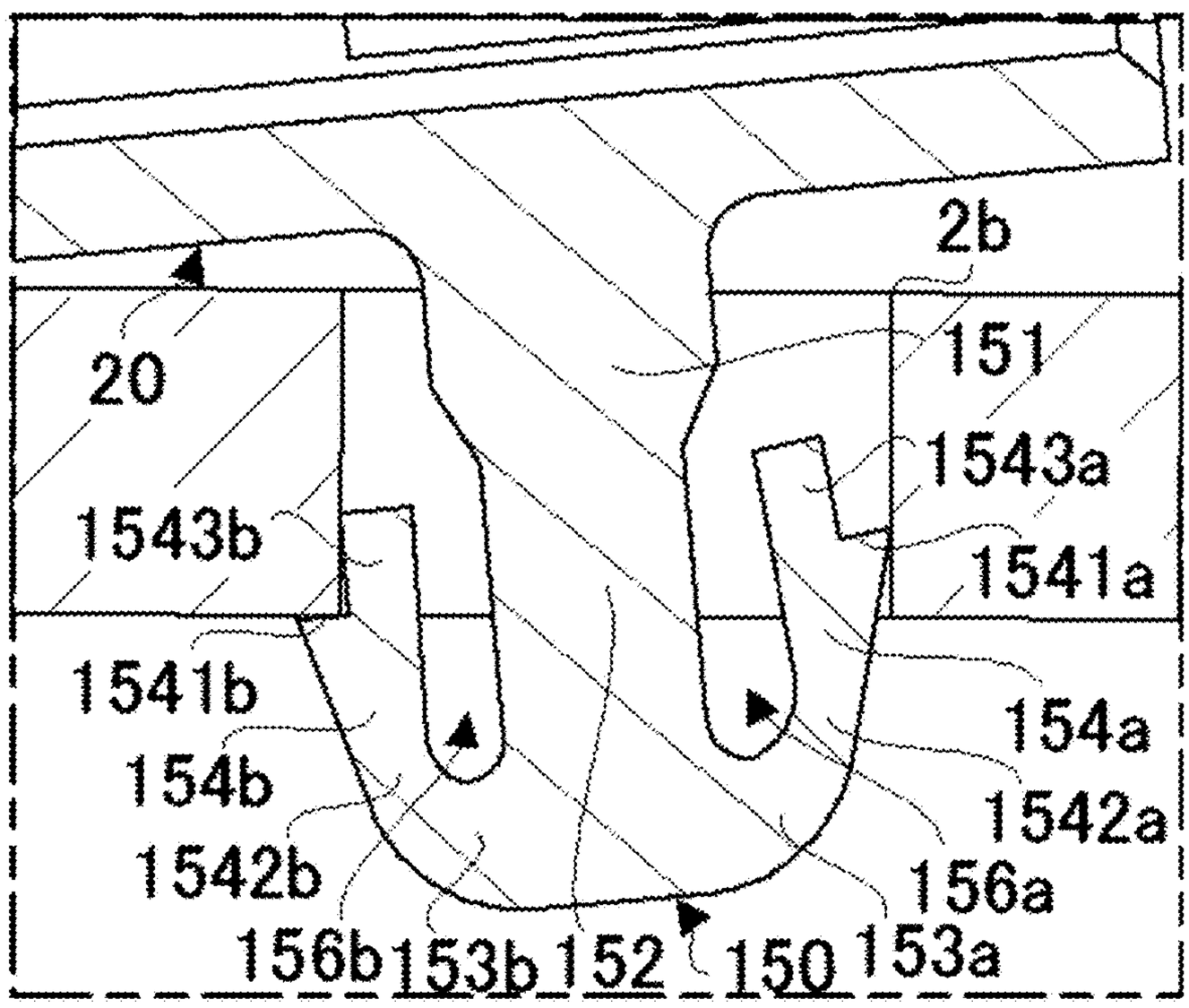
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FIG.9B1

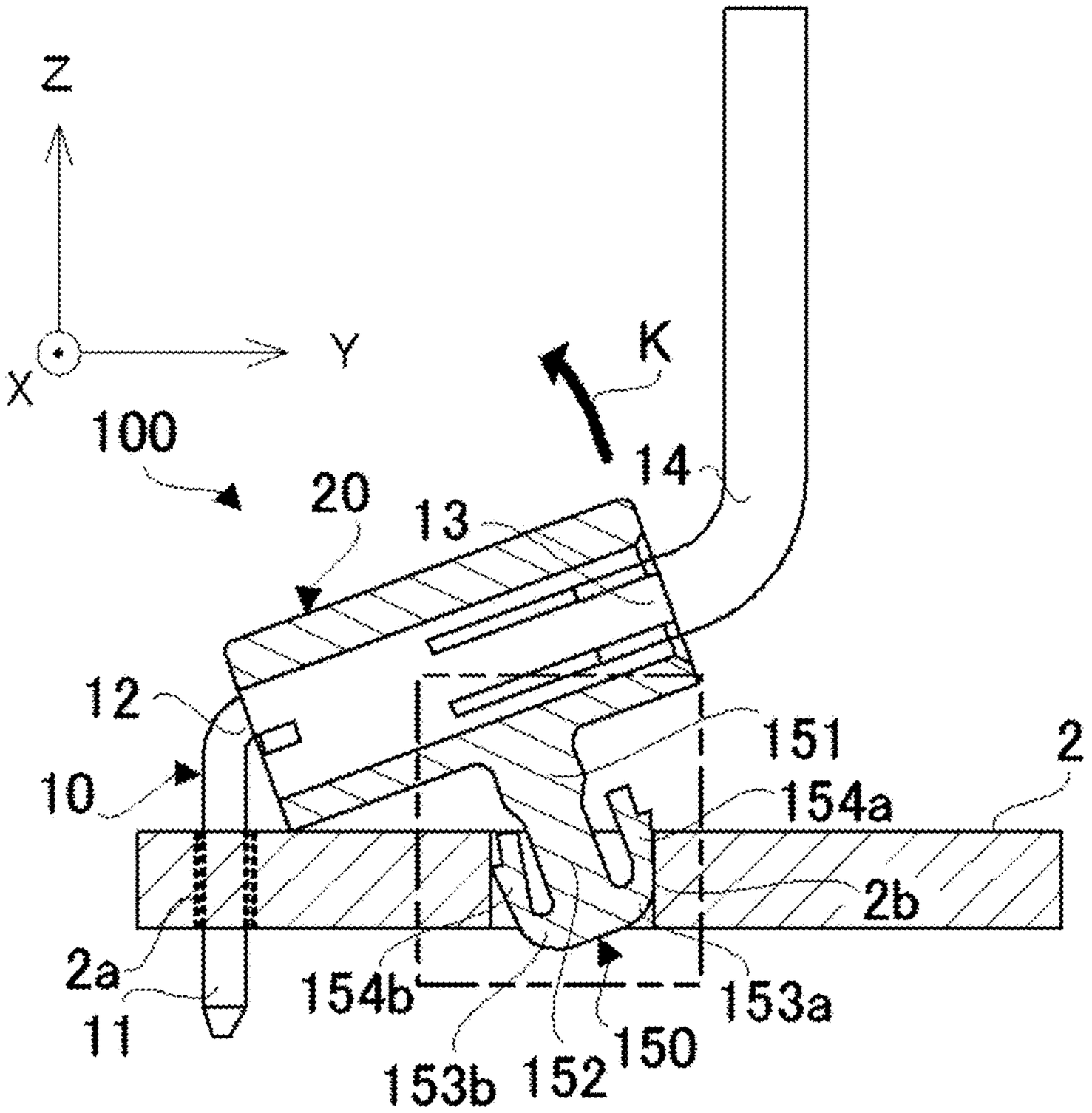
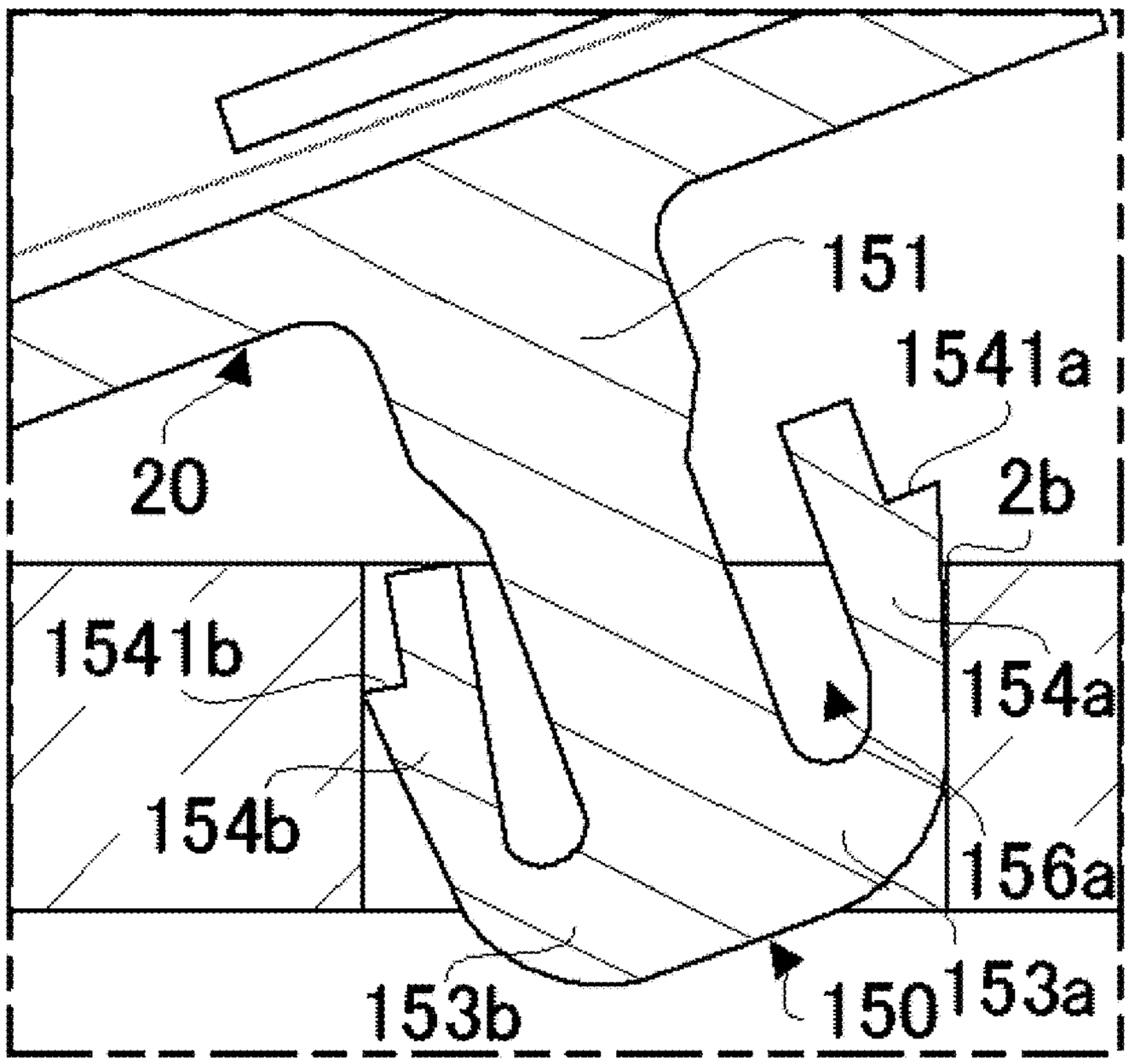


FIG.9B2



BOARD CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of Japanese Patent Application No. 2016-212035, filed on Oct. 28, 2016, the entire disclosure of which is incorporated by reference herein.

FIELD

This application relates to a board connector.

BACKGROUND

In one known technique for mounting a connector on a board, the housing is equipped with a projection that has a retaining engagement claw being opposed to a pin's dip part, and the retaining engagement claw is engaged with the other main surface of the board by inserting the projection into a through hole intended for the projection (see Patent Literature 1, for example).

One known technique for fastening a connector to another member employs a clip that has a pair of resilient engagement pieces at its end (see the clip in Patent Literature 2, for example). In this technique, the clip is inserted into a through hole to cause the pair of resilient engagement pieces to be engaged with an edge of the through hole.

Patent Literature 1 Unexamined Japanese Patent Application Kokai Publication No. 2000-67959

Patent Literature 2 Japanese Patent No. 3185668

SUMMARY

In the board connector described in Patent Literature 1, the retaining engagement claw is opposed to the dip part of a pin. Thus, the board connector involves a problem that, when a great upward force is acted on an end of the connector through, for example, operation of the cable, the housing is pulled toward the cable because the housing rotates around the point of support at which the pin is fastened to the board, the retaining engagement claw is less engaged with the board, and then the retaining engagement claw is released and disengaged from the board.

The connector described in Patent Literature 2 exerts the anchoring (attaching) effect when the pair of resilient engagement pieces are engaged with the board at two positions. However, the connector involves a problem that, when one of the pair of resilient engagement pieces is detached from the object to which the connector is attached, the other piece will also be disengaged.

As seen above, conventional connectors have a problem that the connector is prone to be detached from the object attached thereto, such as a board.

The present disclosure has been made in view of the foregoing circumstances, and an objective of the disclosure is to provide a board connector that is not prone to be detached from the board.

To achieve the aforementioned objective, a board connector according to the present disclosure is for attachment to a board that includes a first through hole and a second through hole, the board connector including:

an L-shaped pin terminal including an insertion inserted into the first through hole and a connecting part extending in a direction orthogonal to the insertion;

a housing disposed on one main surface of the board, the housing containing at least an end of the connecting part and having an opening into which a cable connected to the connecting part is inserted; and

a J-shaped boss formed integrally with the housing, the boss passing through the second through hole and protruding from an other main surface of the board, extending in an opposite direction with respect to a direction toward the insertion, and further extending toward the board.

The boss may include:

a base contiguous to the housing and inserted into the second through hole;

a protrusion contiguous to the base and protruding from the other main surface of the board;

an inversion contiguous to the protrusion, the inversion extending in the opposite direction and being inverted toward the board; and

an end contiguous to the inversion and extending toward the board,

wherein a space may be formed between the protrusion and the end.

The end may be formed such that a thickness of the end in the opposite direction decreases as the end is closer to the inversion.

The boss may be disposed at an end of the housing on a side of a direction in which the connecting part extends.

A plurality of the pin terminals may be disposed to be spaced apart from one another along a direction that is orthogonal to the insertion and is orthogonal to the connecting part, and

a plurality of the bosses may be disposed to be spaced apart from one another along a direction along which the pin terminals are disposed.

Owing to the above-described configurations, the board connector according to the present disclosure is not prone to be detached from a board.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of this application can be obtained when the following detailed description is considered in conjunction with the following drawings, in which:

FIG. **1** is a perspective view of a board connector according to an embodiment of the present disclosure;

FIG. **2** is an exploded perspective view of the board connector in FIG. **1**;

FIG. **3** is a perspective view of the board connector in FIG. **1** seen from the underside;

FIG. **4** is a perspective view of a housing;

FIG. **5** is a side view of the board connector in FIG. **1**;

FIG. **6**A is a diagram intended to explain attaching the board connector to a board;

FIG. **6**B is a diagram intended to explain attaching the board connector to a board;

FIG. **6**C is a diagram intended to explain attaching the board connector to a board;

FIG. **6**D is a diagram intended to explain attaching the board connector to a board;

FIG. **7A1** illustrates the state in which the board connector is attached to a board;

FIG. **7A2** is an enlarged view of the boss in FIG. **7A1**;

FIG. **7B1** illustrates the state in which the end of the boss is engaged with the board;

FIG. **7B2** is an enlarged view of the boss in FIG. **7B1**;

FIG. **8A1** illustrates the state in which a board connector that includes a boss with a pair of resilient engagement pieces according to a comparative example is attached to a board;

FIG. **8A2** is an enlarged view of the boss in FIG. **8A1**;

FIG. **8B1** illustrates the state in which the boss according to the comparative example becomes disengaged;

FIG. **8B2** is an enlarged view of the boss in FIG. **8B1**;

FIG. **9A1** illustrates the state in which the boss according to the comparative example becomes disengaged;

FIG. **9A2** is an enlarged view of the boss in FIG. **9A1**;

FIG. **9B1** illustrates the state in which the boss according to the comparative example becomes disengaged; and

FIG. **9B2** is an enlarged view of the boss in FIG. **9B1**.

DETAILED DESCRIPTION

A board connector **1** according to an embodiment of the present disclosure will now be described with reference to FIGS. **1** to **7**. For ease of understanding, an XYZ orthogonal coordinate system is applied to the drawings and referred to as appropriate, where the −Z-axis direction corresponds to the direction in which an insertion **11** of a below-described pin terminal **10** extends, while the +Y-axis direction corresponds to the direction in which a conductor swaging part **12** of the pin terminal **10** extends.

As illustrated in FIG. **1**, the board connector **1** is mounted on one main surface (the surface on the +Z side) of a printed board **2** placed on an XY plane. The board connector **1** includes a pin terminal **10**, a housing **20**, and a boss **50**.

As seen in FIG. **2**, the pin terminal **10** is formed by bending a conductor, such as an electrically conductive plate material made from copper, aluminum, or the like. As illustrated in FIG. **2**, the pin terminal **10**, which is formed into an L shape, includes the insertion **11** extending in the −Z-axis direction and the conductor swaging part (connecting part) **12** extending in the +Y-axis direction. The conductor swaging part **12** of the pin terminal **10** is electrically connected, via an insulator swaging part **13**, to a core wire conductor of a cable **14**.

The insulator swaging part **13**, which is formed of a member integral with the pin terminal **10**, is coupled to the insertion **11** via the conductor swaging part **12** of the pin terminal **10**. The insulator swaging part **13** is also coupled to an end of the cable **14**, the end being an exposed core wire conductor with its insulator removed. As a result, the pin terminal **10** is fastened and electrically connected to the core wire conductor of the cable **14**.

The housing **20** is formed from a polymeric resin, which is an insulating material, into a rectangular cuboid, and houses and protects the pin terminal **10**, the insulator swaging part **13**, and an end of the cable **14**. The housing **20** includes a top plate **21**, two side walls **22** and **23**, and two partition walls **24** and **25**. The side wall **22** is disposed lateral to the top plate **21** on the side of the −X-axis direction. The side wall **23** is disposed lateral to the top plate **21** on the side of the +X-axis direction. The two partition walls **24** and **25** are placed between the two side walls **22** and **23** to divide the space between the two side walls **22** and **23** into three regions in the X-axis direction.

In addition, as illustrated in FIG. **3**, the housing **20** includes a bottom plate **26** extending from the bottom (the end on the side of the −Z-axis direction) of the side wall **22** in the +X-axis direction, a bottom plate **27** extending from the bottom of the partition wall **24** in the +X-axis direction, and a bottom plate **28** extending from the bottom of the partition wall **25** in the +X-axis direction. A slit **29** is formed in each of the spaces between the bottom plate **26** and the partition wall **24**, the bottom plate **27** and the partition wall **25**, and the bottom plate **28** and the side wall **23**. The slit **29** is wide enough for the insertion **11** of the pin terminal **10** to pass through during assembly, but is not wide enough for the conductor swaging part **12** to pass through.

As illustrated in FIG. **4**, a housing region **30** is formed in each of the following regions: the region enclosed with the top plate **21**, the side wall **22**, the bottom plate **26**, and the partition wall **24**, the region enclosed with the top plate **21**, the partition wall **24**, the bottom plate **27**, and the partition wall **25**, and the region enclosed with the top plate **21**, the partition wall **25**, the bottom plate **28**, and the side wall **23**. Each housing region **30** contains the insulator swaging part **13**, an end of the cable **14**, and an end of the conductor swaging part **12**. The housing **20** includes, at its end on the side of the +Y-axis direction, an opening **31** leading to the housing region **30**.

As illustrated in FIG. **2**, the housing **20** includes, at its end on the side of the −Y-axis direction, a stopper **35**, a lance **36**, and a stopper **37**, which are used for retaining the conductor swaging part **12** and the insulator swaging part **13** of the pin terminal **10** within the housing region **30**. The stopper **35** is formed integrally with the top plate **21**, and protrudes in the −Z-axis direction. The stopper **35** serves as a stopper when the pin terminal **10** is inserted into the housing **20**. The lance **36** is formed integrally with the side wall **22** or the partition wall **24** or **25**, and extends in the +Y-axis direction. The lance **36** retains the pin terminal **10** with a pressing force by pressing the pin terminal **10** that has been inserted into the housing **20**, so that the pin terminal **10** is prevented from coming off the housing **20**. The stopper **37** is formed integrally with the bottom plate **26**, **27**, or **28**, and protrudes in the +Z-axis direction. Along with the stopper **35**, the stopper **37** serves as a stopper when the pin terminal **10** is inserted into the housing **20**. As illustrated in FIG. **2**, the pin terminal **10**, the insulator swaging part **13**, and the cable **14**, which are linked together, are inserted into the opening **31** in the housing **20** (see FIG. **4**). In this step, the insertion **11** of the pin terminal **10** is passed through the slit **29**, and at the same time the insulator swaging part **13** is inserted into the housing region **30** (see FIG. **3**). The conductor swaging part **12** is retained by the lance **36**. Then, as depicted in FIG. **3**, the insulator swaging part **13**, an end of the cable **14**, and an end of the conductor swaging part **12** are housed within the housing region **30**. When every housing region **30** contains the insulator swaging part **13**, three pin terminals **10** are now arranged to be spaced apart from one another along the X-axis direction, which is orthogonal to the insertion **11** and to the conductor swaging part **12**.

As illustrated in FIGS. **3** and **4**, a boss **50**, which is formed integrally with the housing **20**, is placed at an end of the housing **20** on the side of the +Y-axis direction. Two bosses **50** are arranged to be spaced apart from one another along the X-axis direction. As depicted in FIG. **5**, the boss **50** is formed into a J shape and includes a base **51**, a protrusion **52**, an inversion **53**, and an end **54**.

The base **51** is contiguous to the bottom plate **26** or **28** of the housing **20** and extends in the −Z-axis direction. The protrusion **52** is contiguous to the base **51** and extends in the −Z-axis direction. The base **51** and the protrusion **52** are formed so that their lateral faces on the side of the −Y-axis direction are flush with each other. The protrusion **52** is made smaller than the base **51** in the dimension in the +Y-axis direction, creating a step **55** between the lateral faces of the base **51** and protrusion **52** on the side of the +Y-axis direction.

The inversion **53** is contiguous to the protrusion **52**, extends in a direction D**2** opposite to the direction D**1** toward the insertion **11**, and is inverted toward the +Z-axis direction. Note that the direction D**1** is the same as the −Y direction while the opposite direction D**2** is the same as the +Y direction. The end **54** is contiguous to the inversion **53** and extends in the +Z-axis direction. A space **56** is formed between the protrusion **52** and the end **54**. The inversion **53** and the end **54** are formed to protrude in the +Y-axis direction relative to the lateral face of the housing **20** on the side of the +Y-axis direction.

The end **54** includes a flat face **541** orthogonal to the Z axis. The flat face **541** is formed so that the distance L between the flat face **541** and the step **55** of the base **51** is slightly smaller than the thickness of the printed board **2**. This brings an advantage that, for example, when the board connector **1** is mounted on the printed board **2**, the base **51** is smoothly inserted into the through hole **2***b* in the printed board **2** (see FIG. **1**) without any part of the printed board **2** caught between the flat face **541** and the step **55** of the base **51**.

In addition, the flat face **541** is disposed so that the distance L' between the flat face **541** and the bottom plate **26**, **27**, or **28** (the face on the −Z side) of the housing **20**, that is, the distance L' between the flat face **541** and the bottom face of the printed board **2**, is slightly larger than the thickness of the printed board **2**.

A portion of the end **54** adjacent to the inversion **53** forms a resilient deforming part **542**, which can resiliently deform. The end **54** is formed so that its thickness in the +Y-axis direction decreases as the end **54** extends in the −Z-axis direction, or in other words, as the end **54** is closer to the inversion **53**. The lateral face of the end **54** on the side of the +Y-axis direction is sloped toward the −Y-axis direction as the end **54** extends in the −Z-axis direction. Thus, when the boss **50** is inserted into the through hole **2***b* in the printed board **2**, the end **54** can lean in a direction closer to the protrusion **52** (the −Y-axis direction) starting from around the resilient deforming part **542**.

As illustrated in FIG. **1**, the printed board **2** includes a through hole (first through hole) **2***a* and a through hole (second through hole) **2***b*. The through hole **2***a*, into which the insertion **11** of the pin terminal **10** is to be inserted, has a diameter that allows the insertion **11** of the pin terminal **10** to be inserted. A conductor pattern **2***c* is formed on the perimeter of the through hole **2***a*. Three through holes **2***a* are arranged along the X-axis direction with the same pitches as those for the pin terminals **10** so that the insertions **11** of all the pin terminals **10** can be inserted.

The through hole **2***b*, into which the boss **50** is to be inserted, has a diameter slightly larger than the base **51** of the boss **50** allowing the base **51** to be inserted. Two through holes **2***b* are arranged along the X-axis direction, spaced apart by the same distance as that between bosses **50**.

The distance along the Y-axis direction between the centers of the through holes **2***a* and **2***b* is approximately the same as the distance along the Y-axis direction between the centers of the insertion **11** of the pin terminal **10** and the boss **50**.

How the board connector **1** is attached to the printed board **2** will now be described.

In the first place, as illustrated in FIG. **2**, the conductor swaging part **12** of the pin terminal **10** is connected to an end of the conductor of the cable **14** through the insulator swaging part **13**. Next, the cable **14** with the pin terminal **10** placed in front is inserted into the opening **31** in the housing **20** (see FIG. **4**). In this step, the insertion **11** of the pin terminal **10** is passed through the slit **29**, and at the same time the insulator swaging part **13** is inserted into the housing region **30**. When completely inserted, the conductor swaging part **12** is retained by the lance **36**, and, as depicted in FIG. **3**, the insulator swaging part **13**, an end of the cable **14**, and an end of the conductor swaging part **12** are housed within the housing region **30**.

Next, as illustrated in FIG. **6**A, the insertion **11** of the pin terminal **10** is inserted into the through hole **2***a* in the printed board **2**, while the boss **50** is inserted into the through hole **2***b* in the printed board **2**. During this step, as illustrated in FIG. **6**B, the end **54** of the boss **50** comes to abut on an edge of the through hole **2***b*. It should be noted that the end **54** includes the resilient deforming part **542**, and there is a space **56** between the protrusion **52** and the end **54**. Thus, the end **54** leans in a direction closer to the protrusion **52** as seen in FIG. **6**C. Then, when the end **54** comes out of the through hole **2***b*, the end **54** returns to its original posture as depicted in FIG. **6**D.

Subsequently, the insertion **11** and the conductor pattern **2***c* formed on the perimeter of the through hole **2***a* are soldered, and the insertion **11** of the pin terminal **10** is connected to a circuit formed on the printed board **2**.

The board connector **1** in this state, which is illustrated in FIGS. **7**A**1** and **7**A**2**, is fastened to the printed board **2** with the soldered insertion **11** and the boss **50**.

At this point of time, if a force is acted in the +Z-axis direction on an end of the housing **20** on the side of the +Y-axis direction due to, for example, lifting up the cable **14**, the housing **20** rotates in the direction indicated by an arrow K in FIG. **7**B**1** around the point at which the pin terminal **10** is fastened to the printed board **2** or the point at which the pin terminal **10** is bent, the point serving as a point of support. Then, as illustrated in FIGS. **7**B**1** and **7**B**2**, the flat face **541** of the end **54** abuts on the other main surface of the printed board **2**, and the boss **50** is retained on the other main surface of the printed board **2**. As a result, the housing **20** stops rotating. If a force is further acted on the housing **20** in the +Z-axis direction, the rotation of the housing **20** is restricted because the end **54** abuts on the printed board **2**. At this point of time, a force is acted on the end **54** of the boss **50** in the +Y-axis direction. Even when the end **54** moves in the +Y-axis direction caused by the force acted in the +Y-axis direction, the end **54** is not detached from the printed board **2**.

Therefore, the board connector **1** is not detached from the printed board **2** irrespective of a force applied to the board connector **1** in the +Z-axis direction.

For the purpose of making a comparison with the board connector **1** according to the present embodiment, the following describes a comparative example referring to FIGS. **8** and **9**, in which a board connector **100** is equipped with a boss that includes a pair of resilient engagement pieces like the boss described in Patent Literature 2. For ease of understanding, an XYZ orthogonal coordinate system is applied to the drawings and referred to as appropriate, as in FIGS. **1** to **7**. Note that the board connector **100** includes a pin terminal **10** and a housing **20** that are configured in the same manner as in the board connector **1**.

As illustrated in FIGS. **8**A**1** and **8**A**2**, the board connector **100** is equipped with a boss **150** that includes a pair of resilient engagement pieces. The boss **150** is formed integrally with the housing **20** and is placed at a center of the housing **20** with respect to the Y-axis direction. As depicted in FIG. **8**A**2**, the boss **150** includes a base **151**, a protrusion **152**, inversions **153***a* and **153***b*, and ends **154***a* and **154***b*.

The inversion **153***a* and the end **154***a* with the inversion **153***b* and the end **154***b* together form a pair of resilient engagement pieces.

The base **151** is contiguous to the bottom plate **26** or **28** of the housing **20** and extends in the −Z-axis direction. The protrusion **152** is contiguous to the base **151** and extends in the −Z-axis direction. The dimension of the protrusion **152** along the Y-axis direction is made smaller than the dimension of the base **151** along the Y-axis direction, and thus a step **155***a* is formed between the lateral faces of the base **151** and the protrusion **152** on the side of the +Y-axis direction, while a step **155***b* is created between the lateral faces of the base **151** and the protrusion **152** on the side of the −Y-axis direction.

The inversion **153***a* is contiguous to the protrusion **152**, extends in the +Y-axis direction, and is inverted toward the +Z-axis direction. The end **154***a* is contiguous to the inversion **153***a* and extends in the +Z-axis direction. A space **156***a* is formed between the protrusion **152** and the end **154***a*. The inversion **153***b* is contiguous to the protrusion **152**, extends in the −Y-axis direction, and is inverted toward to the +Z-axis direction. The end **154***b* is contiguous to the inversion **153***b* and extends in the +Z-axis direction. A space **156***b* is formed between the protrusion **152** and the end **154***b*.

The ends **154***a* and **154***b* include flat faces **1541***a* and **1541***b*, respectively, orthogonal to the Z-axis (and parallel to an XY plane). Each of the ends **154***a* and **154***b* is formed so that its thickness in the +Y-axis direction decreases as the end extends in the −Z-axis direction, or in other words, as the end is closer to the inversion **153***a* or **153***b*. Portions of the ends **154***a* and **154***b* adjacent to the inversions **153***a* and **153***b* form resilient deforming parts **1542***a* and **1542***b*, respectively, which can resiliently deform. Thus, the end **154***a* can lean in a direction closer to the protrusion **152** (the −Y-axis direction) starting from around the resilient deforming part **1542***a*. Likewise, when the boss **150** is inserted into the through hole **2***b* in the printed board **2**, the end **154***b* can lean in a direction closer to the protrusion **152** (the +Y-axis direction) starting from around the resilient deforming part **1542***b*.

In addition, the ends **154***a* and **154***b* include restricting parts **1543***a* and **1543***b* extending from the flat faces **1541***a* and **1541***b*, respectively, in the +Z-axis direction. When the restricting part **1543***a* abuts on an inner wall of the through hole **2***b*, the movement of the end **154***a* in the +Y-axis direction is restricted. Likewise, when the restricting part **1543***b* abuts on an inner wall of the through hole **2***b*, the movement of the end **154***b* in the −Y-axis direction is restricted.

As illustrated in FIGS. **8**A**1** and **8**A**2**, when the board connector **100** has been mounted on the printed board **2**, the base **151** of the boss **150** is inserted into the through hole **2***b* while the ends **154***a* and **154***b* extend toward the printed board **2**.

When a force is acted in the +Z-axis direction on an end of the housing **20** on the side of the +Y-axis direction due to, for example, lifting up the cable **14**, the housing **20** rotates in the direction indicated by the arrow K in FIG. **8**B**1**. Subsequently, the flat faces **1541***a* and **1541***b* of the ends **154***a* and **154***b* abut on the flat face of the printed board **2** on the −Z side, which causes the boss **150** to be engaged with the printed board **2**, and then the housing **20** and the boss **150** stop rotating.

When a force is further acted on the housing **20** in the +Z-axis direction, the restricting part **1543***b* abuts on an inner wall of the through hole **2***b*, and the movement of the end **154***b* in the −Y-axis direction is restricted, and at the same time the protrusion **152** comes closer to the end **154***b*. As the protrusion **152** comes closer to the end **154***b*, the end **154***a* moves in the −Y-axis direction, and the end **154***a* is released from the printed board **2** as illustrated in FIG. **8**B**2**. Then, the housing **20** rotates in the direction indicated by the arrow K in FIG. **9**A**1**, the flat face **1541***b* of the end **154***b* of the boss **150** is tilted as seen in FIG. **9**A**2**, and the end **154***b* is displaced in the +Y-axis direction and becomes released from the printed board **2** as shown in FIGS. **9**B**1** and **9**B**2**.

As seen above, in the board connector **100** equipped with the boss **150** according to the comparative example, once the end **154***a* is released from the printed board **2**, the end **154***b* also becomes released from the printed board **2**, causing the boss **150** to be disengaged from the printed board **2**.

In addition, as described above, the boss **150** is placed at a center of the housing **20** with respect to the Y-axis direction. Thus, when the cable **14** is lifted up, an end of the housing **20** on the side of the +Y-axis direction serves as a point of effort, while a portion in which the pin terminal **10** is fastened to the printed board **2** or in which the pin terminal is bent serves as a point of support, and the base of the boss **150** serves as a point of application. Hence, a force greater than that acted on the end of the housing **20** on the side of the +Y-axis direction is applied to the boss **150**. Therefore, even when a small force is acted on the housing **20**, the ends **154***a* and **154***b* may be released from the printed board **2**, causing the boss **150** to be disengaged from the printed board **2**.

Accordingly, it is again understood that the board connector **1** of the present embodiment is not prone to be detached from the printed board **2**.

As described above, the board connector **1** according to the present embodiment includes: the pin terminal **10** that is formed into an L shape and includes the insertion **11** to be inserted into the through hole **2***a* in the printed board **2** and the conductor swaging part **12** extending in a direction (+Y-axis direction) orthogonal to the insertion **11**; and the housing **20** that includes the opening **31** which houses at least an end of the conductor swaging part **12** and into which the cable **14** connected to the conductor swaging part **12** is inserted, wherein the housing **20** is to be placed on one main surface of the printed board **2**. The board connector **1** further includes the boss **50** that is in a J shape and is formed integrally with the housing **20**, the boss **50** passing through the through hole **2***b* in the printed board **2** and protruding from the other main surface of the printed board **2**, extending in the direction D**2** (+Y-axis direction) opposite to the direction D**1** toward the insertion **11**, and further extending toward the printed board **2**. As a result, the boss **50** is prevented from being disengaged from the printed board **2** when a force is acted on the housing **20** in the +Z-axis direction caused by, for example, operating or vibrating the cable **14** by accident.

In the board connector **1** according to an embodiment of the present disclosure, the boss **50** includes: the base **51** that is contiguous to the housing **20** and is inserted into the through hole **2***b* in the printed board **2**; the protrusion **52** that is contiguous to the base **51** and protrudes from the other main surface of the printed board **2**, the inversion **53** that is contiguous to the protrusion **52**, extends in the direction D**2** (+Y-axis direction) opposite to the direction D**1** toward the insertion **11**, and is inverted toward the printed board **2**; and the end **54** that is contiguous to the inversion **53** and extends toward the printed board **2**. The space **56** is formed between the protrusion **52** and the end **54**. As a result, when a force is acted on the housing **20** in the +Z-axis direction, the end

54 abuts on the other main surface of the printed board 2, and thus the boss 50 is prevented from being disengaged from the printed board 2.

In the board connector 1 according to an embodiment of the present disclosure, the end 54 is formed so that its thickness in the direction D2 (+Y-axis direction) opposite to the direction D1 toward the insertion 11 decreases as the end 54 is closer to the inversion 53. Thus, a portion of the end 54 adjacent to the inversion 53 forms the resilient deforming part 542. As a result, when the boss 50 is inserted into the through hole 2*b* in the printed board 2, the end 54 leans in a direction closer to the protrusion 52, without creating an obstruction for the boss 50 to be inserted into the through hole 2*b* in the printed board 2.

In the board connector 1 according to an embodiment of the present disclosure, the boss 50 is placed at an end of the housing 20 on the side of the direction D2 (+Y-axis direction) opposite to the direction D1 toward the insertion 11. As a result, when a force is acted in the +Z-axis direction on an end of the housing 20 on the side of the +Y-axis direction, any greater force is prevented from acting on the boss 50.

In the board connector 1 according to an embodiment of the present disclosure, pin terminals 10 are arranged to be spaced apart from one another along a direction (the X-axis direction) orthogonal to insertions 11 and to conductor swaging parts 12. Bosses 50 are arranged to be spaced apart from one another along the direction (the X-axis direction) in which the pin terminals 10 are arranged. As a result, irrespective of whether the housing 20 is formed into a rectangular cuboid whose size along the X-axis direction is larger than its size along the Y-axis direction, the bosses 50 are prevented from being disengaged from the printed board 2.

Embodiments of the present disclosure have been described above, but the present disclosure is not limited to the foregoing embodiments.

In the foregoing embodiments, the pin terminal 10 is L-shaped including the insertion 11 and the conductor swaging part 12. However, the pin terminal 10 may be configured in any way as long as the cable 14 can be connected to a circuit pattern on the board.

In the foregoing embodiments, the pin terminal 10 and the insulator swaging part 13 are described as being integrated with each other into a connecting terminal having a pin. However, the present disclosure is not limited to this. For example, the pin terminal 10 and the insulator swaging part 13 may be different members.

In the foregoing embodiments, the pin terminal 10, the insulator swaging part 13, and the cable 14 are linked together, and the cable 14 with the pin terminal 10 placed in front is inserted into the opening 31 in the housing 20. However, the present disclosure is not limited to this configuration. For example, the housing 20 may include a side wall on a lateral part of the top plate 21 on the side of the −Y-axis direction, and the conductor swaging part 12 of the pin terminal 10 may be passed through and retained on the side wall. Then, the cable 14 coupled to a connecting terminal, which is to be fitted to the conductor swaging part 12, may be inserted into the opening 31, and the connecting terminal may be fitted to the conductor swaging part 12, so that electrical connection is established between the pin terminal 10 and a core wire conductor of the cable 14.

The housing 20 may be configured in any way as long as the housing 20 can house and support a connection among the pin terminal 10, the insulator swaging part 13, and the cable 14.

In the foregoing embodiments, the boss 50 includes the base 51, the protrusion 52, the inversion 53, and the end 54 as illustrated in FIG. 5. However, the present disclosure is not limited to this configuration. The boss 50 need only form a J shape passing through the through hole 2*b*, protruding from the other main surface of the printed board 2, extending in a direction (+Y-axis direction) opposite to the direction toward the insertion 11, and further extending toward the printed board 2. For example, the boss 50 may extend in the −Z-axis direction, and then bend at a right angle toward the +Y-axis direction to extend in the +Y-axis direction, and further bend at a right angle toward the +Z-axis direction to extend in the +Z-axis direction. Such shape of the boss 50 is also referred to as J-shaped.

The foregoing example shows that the end 54 includes the flat face 541 parallel to an XY plane. However, the flat face may be in any shape as long as it can be engaged with the printed board 2 when subjected to an external force. For example, the flat face 541 may not necessarily be parallel to an XY plane. Alternatively, the end 54 may include a non-flat face instead of the flat face 541.

In the foregoing embodiments, three pin terminals 10 are arranged along the X-axis direction while two bosses 50 are arranged along the X-axis direction. However, the present disclosure is not limited to these numbers, and any number of pin terminals 10 and any number of bosses 50 may be arranged. For example, the number of pin terminals 10 may be two or four or more while the number of bosses 50 may be three or more. The number of pin terminals 10 may or may not be the same as the number of bosses 50. Only one pin terminal 10 and only one boss 50 may be disposed. Alternatively, a plurality of pin terminals 10 and one boss 50 may be disposed, or one pin terminal 10 and a plurality of bosses 50 may be disposed.

Furthermore, the above-described materials, shapes, and sizes are example only, and are not meant to be restrictive.

The foregoing describes some example embodiments for explanatory purposes. Although the foregoing discussion has presented specific embodiments, persons skilled in the art will recognize that changes may be made in form and detail without departing from the broader spirit and scope of the invention. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense. This detailed description, therefore, is not to be taken in a limiting sense, and the scope of the invention is defined only by the included claims, along with the full range of equivalents to which such claims are entitled.

What is claimed is:

1. A board connector for attachment to a board that includes a first through hole and a second through hole, the board connector comprising:

an L-shaped pin terminal comprising an insertion inserted into the first through hole and a connecting part extending in a direction orthogonal to the insertion;

a housing disposed on one main surface of the board, the housing containing at least an end of the connecting part and having an opening into which a cable connected to the connecting part is inserted; and

a J-shaped boss formed integrally with the housing, the boss passing through the second through hole and protruding from an other main surface of the board, extending from an end of the housing that is apart from the pin terminal and in a direction opposite to the direction toward the insertion, and further extending toward the board wherein

the boss comprises:

a base contiguous to the housing and inserted into the second through hole;

a protrusion contiguous to the base and protruding from the other main surface of the board;

an inversion contiguous to the protrusion, the inversion extending in the direction opposite to the direction toward the pin terminal and being inverted toward the board; and

an end contiguous to the inversion and extending toward the board,

a space is formed between the protrusion and the end, and the inversion and the end protrude from an end of the housing that is apart from the pin terminal and in a direction opposite to the direction toward the pin terminal (+Y direction).

2. The board connector according to claim **1**, wherein the end is formed such that a thickness of the end in the opposite direction decreases as the end is closer to the inversion.

3. The board connector according to claim **1**, wherein the boss is disposed at an end of the housing on a side of a direction in which the connecting part extends.

4. The board connector according to claim **1**, wherein a plurality of the pin terminals are disposed to be spaced apart from one another along a direction that is orthogonal to the insertion and is orthogonal to the connecting part, and wherein a plurality of the bosses are disposed to be spaced apart from one another along a direction along which the pin terminals are disposed.

5. The board connector according to claim **1**, wherein a cross-sectional area of the base is approximately equal to an area of the second through hole.

6. The board connector according to claim **1**, wherein the boss is further configured to define a gap between the end and the board when the connector is fully inserted.

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